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Volume

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MIT 49 to 59

**FILED**

APR 28 1976

IN THE UNITED STATES DISTRICT COURT  
FOR THE NORTHERN DISTRICT OF ILLINOIS

THE MAGNAVOX COMPANY  
SANDERS ASSOCIATES, INC.

v.

BALLY MANUFACTURING CORPORATION  
MIDWAY MFG. CO.  
EMPIRE DISTRIBUTING, INC.  
CHICAGO DYNAMICS INDUSTRIES, INC.

H. STUART CUNNINGHAM, CLERK  
UNITED STATES DISTRICT COURT

CIVIL ACTION  
74-C-1030

CONSOLIDATED WITH  
CIVIL ACTION  
74-C-2510

IN THE UNITED STATES DISTRICT COURT  
FOR THE SOUTHERN DISTRICT OF NEW YORK

MIDWAY MFG. CO.

v.

THE MAGNAVOX COMPANY  
SANDERS ASSOCIATES, INC.

CIVIL ACTION  
74-Civ.-1657-CBM

IN THE UNITED STATES DISTRICT COURT  
FOR THE NORTHERN DISTRICT OF CALIFORNIA

ATARI, INC.

v.

THE MAGNAVOX COMPANY  
SANDERS ASSOCIATES, INC.

CIVIL ACTION  
75-1442-WTS

**DORIS O. WONG ASSOCIATES**  
**Certified Shorthand Reporters**

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CONTINUED DEPOSITION of MASSACHUSETTS  
INSTITUTE OF TECHNOLOGY by JOHN ALEXANDER MCKENZIE  
and of JOHN ALEXANDER MCKENZIE individually, taken  
pursuant to the Federal Rules of Civil Procedure,  
before Jonathan H. Young, Registered Professional  
Reporter and Notary Public in and for the  
Commonwealth of Massachusetts, at Room E19-758,  
Ford Building, Massachusetts Institute of  
Technology, 50 Ames Street, Cambridge, Massachusetts,  
on Thursday, October 30, 1975, commencing at 9:10  
a.m.

(Mr. Herbert)

PRESENT: Mr. Anderson,

Neuman, Williams, Anderson and Olson (by  
Theodore W. Anderson, Esq. and James T.  
Williams, Esq.), 77 West Washington Street,  
Chicago, Illinois 60602, for The Magnavox  
Company and Sanders Associates, Inc.;

Fitch, Even, Tabin and Luedeka (by Donald L.  
Welsh, Esq. and A. Sidney Katz, Esq.),  
135 South LaSalle Street, Chicago, Illinois  
60603, for Bally Manufacturing Corporation,  
Midway Mfg. Co., and Empire Distributing,  
Inc.;

Flehr, Hohbach, Test, Albritton and Herbert  
(by Thomas O. Herbert, Esq.), 160 Sansome  
Street, 15th Floor, San Francisco,  
California 94104, for Atari, Inc.;

Martin Santa, Esq., General Counsel,  
77 Massachusetts Avenue, Cambridge,  
Massachusetts 02139, for the Massachusetts  
Institute of Technology.

from July 30, 1953 to  
December 2, 1953.

Logbook apparently used  
from December 2, 1953 to  
April 30, 1953.



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P R O C E E D I N G S

MR. ANDERSON: Mr. McKenzie or Mr. Santa, do you have something that you'd like to say on the record?

MR. SANTA: Mr. McKenzie has a statement to make.

JOHN ALEXANDER MCKENZIE, Resumed

THE WITNESS: At the close of the testimony yesterday, we took a tour of the PDP-1/TX-0 facility; and during that time my memory was refreshed on two aspects.

The first, I had testified sometime before noon about the knobs, buttons and switches panel; and I think that I may have inferred incorrectly as to the number of switches and buttons. I referenced the 18-bit test word and the 18-bit buttons and switches. Actually, it's nine switches and nine buttons together which go in as a single word, 18-bit word. The inference probably was wrong, if not the direct testimony.

The second point, as we were going to break at six o'clock, Mr. Katz pointed to the color display and said "Is this the second display?"

1 And that brought to mind an earlier question,  
2 when I was asked something about other Space War  
3 games.

4 Up to that point, all of the testimony  
5 had been focused on the point that all of the  
6 versions that we talked about were conceptually  
7 the same game; and I had made the statement  
8 several times that basically they were the same  
9 as the game first developed. There has been some  
10 work by a student who was a student at the time  
11 he started it. The student's name is Winston  
12 Edmond. He graduated, bachelor's, in '73, I  
13 believe; and he had used the TX-0 linked to the  
14 PDP-1 in a game that he called Porthole Space War.  
15 I think the reason it did not come to mind was  
16 that I don't consider it the same game -- but  
17 that's my personal opinion, interpretation -- and  
18 certainly the title would not direct it that way.  
19 And possibly it would be open to other interpre-  
20 tations. Conceptually, this game is considerably  
21 different. It requires two display scopes; and  
22 rather than viewing all of the action happening  
23 in space, the concept here is that you're sitting  
24

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1 within a spaceship looking out through a porthole  
2 into space. You have a control switch to allow  
3 you to rotate the ship, tilt the ship. There is  
4 a horizon display; and the idea of perspective,  
5 when you view the other ship in the distance.  
6 And there are many -- well, this is still in the  
7 process of development.

8 There are several switches, none of  
9 which I can testify to; as a matter of fact, I can  
10 only testify in most general terms to any of this.  
11 There are various options to give you tabulations  
12 on the screen, such as how much fuel you have  
13 left; and I'm not sure whether it's an altitude  
14 or not, but specification, updating, readings of  
15 that nature.

16 After the first work between the TX-0  
17 and the PDP-1, we obtained the color scope on  
18 indefinite loan from the Artificial Intelligence  
19 Group; and that made it easy to do the whole  
20 thing on the PDP-1. Of course, it's rather nice  
21 in the color scope, where you either have these  
22 explosions and things in color, utilize all the  
23 facilities. I have played the game a couple of  
24 times. One time it was during the day; and it was

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1 left on the machine, and I fooled with it. I did  
2 not become very adept at it. He has never left  
3 the tape around. To the best of my knowledge,  
4 it has not been displayed to the public. He has  
5 given personal demonstrations. All of the students  
6 involved with this during this time -- not all;  
7 many of the students have been aware of it.  
8 There's been no effort to keep it secret.

9 That's about the extent of my testimony.  
10 My only question was whether I forthrightly  
11 answered the question.

12 DIRECT EXAMINATION, Continued

13 BY MR. WELSH:

14 Q Has all this occurred in the last four or five  
15 years?

16 A Yes. To the best of my knowledge, this student  
17 graduated in '73; and I would say maybe two years  
18 before that he had done some work. That two may  
19 be closer to one. I cannot speak very  
20 significantly or very knowledgeably beyond what  
21 I've said.

22 Q Where is Mr. Winston Edmond now?

23 A He is now working in Cambridge at Bolt, Beranek  
24 and Newman.

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1           The other thing that brings this to  
2 mind is that he knows I'm testifying today. I  
3 called him at some time after I'd been alerted  
4 that I would be subpoenaed. I called him in  
5 reference to some work that he had done here on  
6 a weekend assisting a user; and I wanted to know  
7 what he had meant by it. And the idea of what's  
8 new came up; and I told him -- and I asked if he  
9 would feel that all of his work on the Space  
10 War -- no; I said I was going to try to  
11 characterize that the current, all of the current,  
12 Space Wars are basically the same as the original  
13 one. He said "That's true." He said he would  
14 consider what he did embellishments.

15           But I was not referencing his own game;  
16 at least that was not what I expected. My  
17 testimony was to the game we have been discussing  
18 the last two days. My thoughts, at least.

19           MR. WELSH: Mr. Anderson --

20 Q       Are you finished, Mr. McKenzie?

21 A       Yes.

22           MR. WELSH: We've been reviewing  
23 scheduling in this matter, and have been in  
24 contact with the people at DEC, who have witnesses

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1 standing by. I don't know how long your cross-  
2 examination of Mr. McKenzie is going to take.

3 You have indicated that you will not be available  
4 under any circumstances for tomorrow; and we wish  
5 to examine, again, the materials that are over  
6 at the PDP-1 facility. There are a couple of  
7 them that are at least one box of tapes in fossil  
8 that I would like to have identified before we  
9 adjourn from here.

10 It occurs to me that we will not be  
11 able to complete depositions in Maynard under  
12 any circumstances; and I therefore propose that  
13 after the cross-examination and redirect  
14 examination of Mr. McKenzie are completed we  
15 terminate Mr. McKenzie's deposition and continue  
16 the deposition of MIT; and either adjourn to the  
17 PDP-1 facility with the Reporter so we can  
18 identify that one box of tapes that I did see  
19 over there and then continue the deposition of  
20 MIT until we've had a chance to examine those  
21 documents more fully. I'm suggesting that we  
22 also continue the DEC and Russell depositions.  
23 We have been in contact with DEC personnel this  
24 morning, as I said; and they are willing to agree

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1 to continue them to a time convenient to the  
2 parties here, subject to everyone's agreement  
3 of course. Tentatively, they suggested -- or  
4 dates which are available to them, are the week  
5 of December 1. They are standing by now.

6 As I said, if we can reach an agreement  
7 on the scheduling, then we should advise them so  
8 they don't continue to have the people waiting.

9 MR. ANDERSON: Is that the earliest  
10 date that they can be available?

11 MR. WELSH: Well, there is next week.

12 MR. ANDERSON: Which we've available  
13 for, but you're not; is that right?

14 MR. WELSH: That's right. We now have  
15 depositions scheduled for Wednesday.

16 MR. KATZ: I believe December 1 is the  
17 first full week.

18 MR. WELSH: Yes. It was the first full  
19 week. The next week, the 10th, we're scheduled  
20 to go back to San Francisco; and the following  
21 week we're scheduled --

22 MR. ANDERSON: November 10?

23 MR. WELSH: Did I say December?

24 MR. ANDERSON: You said December 1.

1           MR. WELSH: No. The next week after,  
2           the next one coming up. The following week.

3           MR. ANDERSON: November 10, we're  
4           scheduled to be in San Francisco?

5           MR. WELSH: Right. And November 19,  
6           for the rest of that week and the following week,  
7           we're scheduled in New Hampshire; which brings us  
8           up to the week of December 1. We wanted to leave  
9           a whole week. We're not sure what documentation  
10          they have, or how long Mr. Russell is going to  
11          take.

12          MR. KATZ: They said they had quite a  
13          bit of documents this morning; apparently three  
14          people.

15          MR. WELSH: So we were hoping to  
16          schedule it to begin at the start of a week, so  
17          we could complete it after we started; instead of  
18          doing this piecemeal, as would be necessary if  
19          we tried to go up there today.

20          MR. ANDERSON: Well, I don't object to  
21          doing it piecemeal. As a matter of fact, a full  
22          week of any one case is more than the Reporter  
23          indicated he can take; and I feel the same way.  
24          I think that three days on any one case is enough.

1 If you think it's going to take more than that --

2 MR. WELSH: I don't think it will; but..

3 Now, we are not sure yet of the  
4 availability of Mr. Russell that week. We did  
5 get a contingent alternative with the DEC people  
6 for the following week.

7 MR. ANDERSON: It's a little disconcert-  
8 ing that it took the Defendants a year and a half  
9 to take their first deposition; and now we're  
10 being inundated. I don't know why the Defendants  
11 could not have done something in the last year  
12 and a half.

13 MR. WELSH: Well, for one thing, our  
14 interrogatories were not answered with respect to  
15 the two patents that are in the New York suit  
16 and not in the Chicago suit. We felt that it was  
17 not wise to go piecemeal to take depositions with  
18 respect to only two of the four patents in issue  
19 there.

20 MR. ANDERSON: They're not in issue,  
21 Mr. Welsh.

22 MR. KATZ: They're in issue in New York.

23 MR. ANDERSON: They're not in issue in  
24 New York.

1 MR. KATZ: These depositions are  
2 noticed in New York as well as in Chicago.

3 MR. ANDERSON: Those two patents are  
4 not in issue in New York or in Chicago, because  
5 you elected not to put them in issue in Chicago  
6 and we've resisted having them in issue in New  
7 York.

8 MR. WELSH: Well, I don't know --

9 MR. ANDERSON: No answer has been filed  
10 in New York. This is not the time to belabor  
11 that.

12 MR. WELSH: That's right; I agree. I  
13 don't think it's worthwhile to argue about what  
14 has been done so far.

15 MR. ANDERSON: And also, of course,  
16 we'll be discussing scheduling with the judge on  
17 November 4; and he may have some ideas of his  
18 own on what the proper schedule is.

19 So I think, to expedite things for  
20 today, I'm inclined to agree with you that it  
21 would be desirable to finish here at MIT if we  
22 possibly could; and to that end I'm willing to  
23 forego the proceeding at DEC today. It does  
24 seem to be difficult. But I would suggest that

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1        what we do then is you immediately go ahead, and  
2        we'll let you look at the fossil tapes or  
3        whatever else you want to do; complete your  
4        direct, and then we'll do our cross after you've  
5        completed your direct. All right?

6                MR. WELSH: Fine.

7                MR. ANDERSON: Let's do that.

8                Do you want to go over to -- urn to

9                MR. WELSH: No. I want to wait until  
10       we're completed with the direct here, and cross  
11       and any redirect.

12               MR. ANDERSON: Well, I would like you  
13       to complete your direct. Now, I understand you  
14       have not completed your direct; so let's get the  
15       direct finished, and then I'll cross after that.  
16       No sense in crossing piecemeal. I'd just as soon  
17       cross completely when you're through.

18               If it's all right with Mr. McKenzie,  
19       let's get the job done; and Mr. McKenzie may  
20       identify any other documents or tapes that they'd  
21       like, and we'll get them identified and complete  
22       the direct and cross.

23               And Mr. Santa, I think that's the most  
24       orderly way to proceed.

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1 THE WITNESS: I'm in agreement.

2 MR. WELSH: Well, are you open now,  
3 in the event the court will approve --

4 MR. ANDERSON: For December 1?

5 MR. WELSH: Yes.

6 MR. ANDERSON: Yes.

7 MR. WELSH: Okay.

8 MR. ANDERSON: So we'll adjourn to  
9 Room 26-260 or whatever?

10 MR. WELSH: Right. I would suggest  
11 bringing whatever you want back here rather than  
12 trying to continue the deposition over there;  
13 subject to your thoughts, Mr. Santa. This is a  
14 good place to take a deposition.

15 MR. SANTA: Well, I'm not familiar  
16 with what's over there; so I really can't make  
17 any decision.

18 MR. WELSH: Well, the facility may be  
19 in use by other people; I don't know.

20 THE WITNESS: There is some activity  
21 there.

22 MR. WELSH: Okay.

23 MR. ANDERSON: Hopefully, we're going  
24 to finish the inspection, say, by noon and cross

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1       this afternoon.

2               MR. WELSH: Well, there are only a  
3       couple of things that I know of at this time.  
4       The inspection -- if we're still on the record,  
5       Mr. Herbert suggested that anything that Mr.  
6       McKenzie finds that he would tend to throw away  
7       in his forthcoming move, we're going to request  
8       that that material be preserved in some place of  
9       safekeeping by the Institute until we've had a  
10      chance to go over every bit of it; which  
11      considering the amount of material that there is  
12      would take longer than we'd surely want to spend  
13      today.

14             At the moment, we just want to go  
15      through the fossil drawer, which I think we can  
16      do rather quickly; and it shouldn't take us over  
17      an hour, or perhaps a half hour.

18             MR. ANDERSON: All right; fine. We just  
19      want to close this and subpoena the deposition  
20      out. Whenever you're finished, we'll cross and  
21      we'll finish; and if you decide then later that  
22      you've found something in Mr. McKenzie's rubbish  
23      that you'd like to examine the witness on, that's  
24      been considered legal with respect to Dr.

1 Kissinger; and I guess it's all right here too.  
2 That will be a separate proceeding, as I view it.

3 MR. WELSH: Well, in any event we'll  
4 complete the deposition of Mr. McKenzie. Whether  
5 we consider the deposition of MIT completed or  
6 continuing I think is another question; but I  
7 suggest we proceed now.

8 MR. ANDERSON: All right.

9 [Recess.]

10 Q (By Mr. Welsh) After I indicated completion of  
11 my direct examination, Mr. McKenzie, I recall  
12 that you had one or more other documents which  
13 you had brought with you in response to the  
14 subpoena. I wonder if you would take one of them  
15 and tell us what it is, please.

16 A Yes. This is a card that folds into four pages;  
17 and it contains a listing of the order code of  
18 the PDP-1, and it represents the order code that  
19 would have been effective over the range of the  
20 time period that has been discussed to date.  
21 My thinking of that is that it was bracketed by  
22 the delivery date 1961 and, shall we say, '64  
23 or '65. We may have ranged beyond. But this  
24 would be applicable, certainly, for paper tapes;

1 maybe not through all the discussion.

2 MR. WELSH: Would the Reporter please  
3 mark that card as Exhibit 49.

4 [Four-page card containing  
5 listing of PDP-1 order code,  
6 marked MIT Deposition  
Exhibit No. 49 for identi-  
fication.]

7 Q Where did you obtain this card when you were  
8 gathering your documents to bring to this  
9 deposition?

10 A They were taken from the drawer of my desk.

11 Q And how long had it been in the drawer of your  
12 desk prior to the time you took it out to bring  
13 it to this deposition?

14 A For several years. It's actually one of several  
15 that I have.

16 Q Do you know when you obtained this particular  
17 card?

18 A I don't know. They were issued in large  
19 quantities as handouts by Digital Equipment  
20 Corporation, in somewhat the same fashion that I  
21 testified to with respect to the PDP-1 manual, I  
22 believe labeled -- "check out the computer."

23 Q Exhibit 10.

24 A -- Exhibit 10; and were made available to all

1 users for as long as we could use them. In other  
2 words, they came down by the hundreds.

3 Q Did a card like this accompany the PDP-1 when it  
4 was delivered to MIT?

5 A I recall reading the first page of the log that

6 I had a notation in there; there was one card  
7 available, and not to take it away. That was the  
8 sole documentation the first two or three days.

9 Q I refer you to Exhibit 4, which is the logbook.  
10 Is that the logbook you referred to in your last  
11 answer?

12 A Yes, it is; and the entry I refer to is on 10,  
13 Page 1.

14 Q Would you read that entry, please?

15 A Do you need the time and date?

16 Q Yes, please.  
17 MR. ANDERSON: I object. The document  
18 speaks for itself.

19 A Friday, September 22, 1961. My -- well, they're

20 all my entries. "1100 John Shields and Barrett  
21 Prichard from DEC. 1230 power on. Check out" --  
22 poor English. "Check out the computer."

23 Initialed "JAM." 1800 checked out typewriter,  
24 punch, reader, memory, address check okay power



1 off all okay clock equal 128.3 windows closed -  
2 door locked. Please leave the instruction list  
3 card on console. They are scarce now, but they  
4 will be available to everyone shortly." I have  
5 initialed that, "JAM."

6 Q What was the other document that you brought with  
7 you?

8 A The second one is listed, Programmed Data  
9 Processor-1, DEC's File Index F-11A. It is one  
10 of their advertising handouts using the PDP  
11 computer; and it's just a condensed version of  
12 everything of which is available in Exhibit 10.  
13 It also contains the list of the PDP-1  
14 instructions.

15 Q Where did you obtain --

16 MR. WELSH: First, would the Reporter  
17 please mark this as Exhibit 50.

18 [PDP-1 advertisement, marked  
19 MIT Deposition Exhibit No.  
20 50 for identification.]

21 Q Where did you obtain Exhibit 50 in order to  
22 bring it to this deposition?

23 A It was in one of the file cabinets in Room 26-248.

24 Q Now, do you know how long prior to the time you  
took it out for this deposition it had been there?

1 A That would have been available within the first  
2 year of the computer; that is, the first year  
3 dated from the middle of 1961.

4 Q Does Exhibit 50 bear any indication of a date?

5 A DEC uses a code; on the back, "Printed in U.S.A.  
6 9/61."

7 Q How do you determine that this would have been  
8 received within a year? I presume you mean a  
9 year after the PDP-1 was received?

10 A Yes. Well, by that time I had collected,  
11 probably, 10 or 12 of those. I wasn't interested  
12 in picking up any others. I'm not sure how my  
13 hands came on that; possibly at a trade show.

14 Q In a recent It was not unlikely that in one of the  
15 cartons with the supply of manuals numbered  
16 Exhibit 10, that there were a dozen or so of  
17 these. It would have been that sort of thing.  
18 It was an advertising brochure.

19 Q Did you yesterday -- or I should say the day  
20 before, and yesterday -- bring any other  
21 documents or things in response to the subpoena?

22 A No. I think that concludes everything I carried  
23 over; and as I felt, representative items in  
24 response to what I felt was rather a broad list,

1 attachment; broad interpretation. And I couldn't  
2 possibly carry everything.

3 We did discuss, but it was never  
4 entered, the receipt or the shipping paper from  
5 the package of the logbooks, Exhibits 4, 5, 6  
6 and 7, as they were returned from micro-  
7 reproduction to me.

8 Q Yes, I recall that. I don't believe we will mark  
9 that as an exhibit.

10 A That's the only . . .

11 Everything else you see in my case are  
12 Xerox copies of things that have been

13 requisitioned from me.

14 Q In a recess this morning, did you accompany Mr.

15 Katz, Mr. Williams, Mr. Anderson, Mr. Herbert

16 and me back to Room 26-248 and observe us

17 examining documents and things in that room?

18 A Yes. That was, in a sense, a continuation of the  
19 same sort of thing that we did yesterday from

20 5:00 to 6:00 p.m.

21 Q Did we ask you, then, during that time to bring  
22 with you other documents?

23 MR. ANDERSON: Might I just say for  
24 the record that last night we spent approximately

1 one hour at Room 26-260 and -248, and this morning  
2 about two hours, from nine to roughly eleven,  
3 inspecting documents and things in the same  
4 location.

5 MR. WELSH: I think it was about 9:30  
6 by the time we got there.

7 Q Would you take first the black notebook which is  
8 among the things which were brought at our  
9 request. Would you tell us what that is.

10 A This is labeled "PDP-1 Maintenance Manual Digital  
11 Equipment Corporation." I have lettered in on  
12 the label "McKenzie 26-248."

13 Q What is the form of that manual?

14 A This is a loose-leaf binder.

15 Q And does it contain pages of information that  
16 are bound in in a loose-leaf binder manner?

17 A Yes, it does.

18 Q Could you describe further what is contained in  
19 that manual by way of information generally?

20 A Yes. This was written to aid the person doing  
21 maintenance on the PDP-1 computer. There is a  
22 description of the logic from a philosophical  
23 point of view, what is trying to be done; and  
24 then it would go on to explain in more detail

1 what is being done, and the ideas that a person  
2 working with this and with the accompanying  
3 drawings which we've referenced yesterday, the  
4 figure number that I read, would correspond to  
5 the figure number discussed in the text.

6 Q You're referring by "drawings" to Exhibits 25  
7 through 43?

8 A Yes, definitely. And having the maintenance manual  
9 and the drawings together would enable an  
10 experienced maintenance person to perform  
11 maintenance on a standard PDP-1 computer.

12 This is also used in conjunction with  
13 a maintenance course which was offered at DEC  
14 during the periods of the PDP-1 computer.

15 Q Did you take that course?

16 A I did not. The technician working with me, John  
17 Connolly, did.

18 Q How long was the course?

19 A I think I testified once it was two weeks.  
20 Possibly it was one, but I kind of believe it  
21 was two.

22 Q Did anyone else that used the PDP-1 computer take  
23 that course, that you know of?

24 A No one in our particular group.

1 Q None of the users either?

2 A Oh, no.

3 Q Were any courses given at MIT by DEC personnel  
4 regarding the construction of the PDP-1 computer?

5 A I recall that there was a seminar. Whether this  
6 was in connection with a course or the EE Depart-  
7 ment, I'm not sure just who it was sponsored by.  
8 In any case, it was meant for the students; and  
9 whether there were one or more persons from DEC,  
10 I know specifically that Benjamin Gurley from DEC  
11 came down and discussed the PDP-1 computer.

12 Q And do you know approximately how long that  
13 seminar lasted?

14 A It was on the order of two hours.

15 Q Do you know when it was given?

16 A It was during the early history of the PDP-1;  
17 I would expect within the first year.

18 Q Did any of the student users of the PDP-1 take  
19 the course?

20 A It was not a course. It was just --

21 Q Or seminar?

22 A It was just a lecture one afternoon. I use the  
23 term "seminar." It was just an informative

24 lecture one afternoon; and a question-and-answer



1 period following.

2 Q Do you know how this manual got into the PDP-1  
3 facility?

4 A It was mailed to me.

5 Q Personally?

6 A Yes.

7 Q Do you know when that occurred?

8 A I testified yesterday that the documentation was  
9 somewhat late arriving. We first received a  
10 preliminary manual, which started Chapter 7 --

11 Q I think it was the arithmetic unit. This was  
12 probably six months later; I can't say for sure.

13 Q Within six months after you acquired the PDP-1?

14 A Yes. Maybe not quite that late, but there was  
15 a delay in there.

16 Q You stated that this was written to aid the user  
17 of the PDP-1.

18 A No, not the user. I distinguish between  
19 servicing and user.

20 Q I'm sorry.

21 A This was for servicing the machine, from a  
22 maintenance point of view.

23 Q To aid in the servicing, then?

24 A Yes; to correct malfunctions when they occurred.

1 Q And from whom did you receive that manual?

2 A I think it was in the mail; I'm not sure. I don't  
3 believe it was handed to me personally; though it  
4 possibly was.

5 Q From DEC?

6 A Yes. It may well have come down through the DEC  
7 field service. They gave us rather good support  
8 during the first six months. It may well have  
9 been carried down by the DEC field service

10 engineer.

11 Q Was it accompanied by the drawings that were  
12 numbered yesterday?

13 A That is my recollection.

14 Q Have you used this manual in servicing the PDP-1  
15 computer?

16 A Yes.

17 Q During what period of time have you used this  
18 manual?

19 MR. ANDERSON: I object. I think this  
20 entire line of questioning has been asked and  
21 answered, including this particular question.

22 A I've used it since I first received it. However,  
23 its value has been decreased somewhat; since at  
24 this time there is very little of it that

1 represents the current state of the hardware in  
2 the PDP-1 computer. There is one area referenced  
3 in the memory, core memory, modules, which is  
4 still applicable; also, some of the references  
5 to the punch interface which I discussed  
6 yesterday. And the typewriter, when it is used  
7 off line, it can be -- it is switched to either  
8 off line or on line usage. That's about the  
9 limit.

10 Q At the time you received the manual, did it  
11 represent the state of the PDP-1 computer?

12 MR. ANDERSON: I object. I think it's  
13 been asked and answered; and the question is  
14 actually in part contrary to the evidence.

15 A Yes; although it's not unlikely there was a  
16 change order in effect, with some minor

17 modifications.

18 Q Does it contain the original pages that it had  
19 when you received it?

20 A I couldn't swear to that. I would expect so,  
21 but I have no way of knowing.

22 Q Do you recall removing any pages?

23 A I did not.

24 Q Do you recall adding any pages?

1 A No. But there could have been a follow-up. I'm  
2 just not sure of that.

3 Q Did you make any notations of your own on any of  
4 the pages?

5 A I'd expect -- it's customary for me in servicing  
6 to make notations. I wouldn't know where to find  
7 a specific entry.

8 Q Now, when we asked if this manual could be marked  
9 as an exhibit, you indicated a continuing need  
10 for it; and Mr. Anderson and I with Mr. Herbert  
11 concurring were able to agree that the manual  
12 may be copied on microfilm, and I believe your  
13 counsel or counsel for MIT has agreed to undertake  
14 the acquisition of the microfilm, with one copy  
15 for Mr. Herbert, one copy for Mr. Anderson, and  
16 one copy for me.

17 MR. WELSH: Mr. Anderson, I'd like to  
18 ask you at this time if we may stipulate that a  
19 copy of the manual reproduced from the microfilm  
20 may be marked as Exhibit 51; and that that copy  
21 may be substituted for this original and used in  
22 the suit as if it were the original, with the  
23 understanding that corrections may be made where  
24 indicated.

1 A MR. ANDERSON: Yes; subject to our right  
2 to inspect the original at reasonable times and  
3 subject to correction if error should appear,  
4 that's acceptable.

5 MR. WELSH: Is that agreeable with you,  
6 too, Mr. Herbert?

7 MR. HERBERT: Yes, certainly.

8 [Copy of PDP-1 maintenance  
9 manual reserved as MIT  
10 Deposition Exhibit No. 51  
for identification.]

11 Q Now, Mr. McKenzie, would you please take the other  
12 documents which I asked you to bring --

13 MR. ANDERSON: Excuse me, Mr. Welsh.  
14 Did you give the maintenance manual a number?

15 MR. WELSH: 51.

16 A Do I have to worry about order in these? That's  
17 what I'm trying to arrange. If you don't care,  
18 I won't.

19 Q I would prefer if they -- first of all, I'd like  
20 to ask you what you have before you now.

21 A I have before me five logbooks from the PDP-1  
22 computer.

23 Q And does each of them extend from one date to  
24 another date?

1 A Yes, they do.

2 MR. ANDERSON: I object. I don't know  
3 what that means.

4 MR. WELSH: Well, cover a particular  
5 period of time.

6 Q Does each of them cover a particular period of  
7 time?

8 A The front cover has a label; and entered on the  
9 label -- well, the label says "Used from." There's  
10 an entry date; and "To," with another date.

11 There is an exception to that. One of  
12 them is a red loose-leaf notebook similar to  
13 Exhibit No. 7 -- I may be corrected on that --  
14 which was earlier referenced; and there is no  
15 indication of page number or date or anything  
16 else. The other four are computation books with  
17 page numbers.

18 Q Can you tell from the entries in the notebook  
19 what period of time is covered in that?

20 A Yes.

21 Q In the notebook?

22 A Oh, I'm sorry. I see.

23 The front page, 2/24. On the back of  
24 the front page, 2/25/65. There are empty pages

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1 in the back of the book. A cursory examination  
2 of the last page with an entry, 21 July.

3 A This is I go back two pages; I find the date  
4 17 July '65. It has the number 2323.

5 Q Would you arrange these in chronological order,  
6 please. This is the type of book which is used

7 A All right. activity; and it contains a number

8 Q Taking the book covering the earliest period of  
9 time, which book is that? ity, and is accountable,

10 A Back to the loose-leaf notebook with the red  
11 cover. ited.

12 Q And I believe you stated that that, in the front,  
13 contained a date, 2/24.

14 A On the back, the first page contains the date  
15 2/24. On the back of the front page is the date,  
16 2/25/65. more properly express. "Property of the

17 Q And the last page with entries? ies. This notebook

18 A This is the same book that I testified to --

19 Q Just a moment ago? cetera; and is to be returned

20 A Two statements back. your termination from the

21 library." MR. WELSH: I'd like to ask the Reporter  
22 to mark this notebook as Exhibit 52. the Reporter

23 to mark that book as [Logbook apparently used  
24 from February 24, 1965 to  
July 21, 1965, marked MIT  
Deposition Exhibit No. 52  
for identification.]



1 Q What is the next logbook that you have selected?  
2 Could you just describe it?

3 A This is an MIT computation book. It has the  
4 title "PDP-1 Log." It has the number 2323.  
5 These books had to be requisitioned from the MIT  
6 library. This is the type of book which is used  
7 in research activity; and it contains a number  
8 and was thought of, considered, as being MIT --  
9 specifically RLE -- property, and is accountable,  
10 supposed to be returned when the party using it  
11 terminates.

12 The dates listed are July 20, 1965 to  
13 December 2, 1965.

14 I was looking above to try to explain  
15 the number. I think, if I read the label on here,  
16 it will more properly express. "Property of the  
17 research laboratory of Electronics. This notebook  
18 is provided for use to record research notes,  
19 graphs and data, et cetera; and is to be returned  
20 to Room 26-244 upon your termination from the  
21 library."

22 MR. WELSH: I'd like to ask the Reporter  
23 to mark that book as Exhibit 53, please.

24 MR. ANDERSON: I object to marking

1 these books as exhibits for identification on  
2 the ground that I see absolutely no relevance;  
3 none has been established. It encumbers the  
4 record; and I believe if you insist on putting  
5 that volume of material in, that you should  
6 provide us with a copy so that we will have access  
7 to them, the same access that you'll have to them.  
8 provide t MR. WELSH: We will have the originals  
9 in our office available for your inspection at  
10 any time, Mr. Anderson. In the course of these  
11 proceedings, MR. ANDERSON: Well, that's not the  
12 same as having them available as you'll have them  
13 available. after this subpoena to exhibit  
14 possession I see no relevance. You've made no  
15 effort to establish relevance. I object to the  
16 questions about them as irrelevant and immaterial;  
17 and I see no purpose in it. with copies  
18 of these THE WITNESS: Mr. Anderson's statement  
19 reminds me of a statement that I wanted to make  
20 on our way back. That was to the effect that I  
21 would be reluctant to testify anything beyond  
22 what I'm doing if I didn't have access to a book  
23 like this, or at least a copy of this book. I'm  
24 not sure that it's in my prerogative to refuse to;

1 but I would feel severely handicapped if I had  
2 to testify beyond this point if I did not have a  
3 copy of this available for some period of time  
4 before I'd be called upon.

5 MR. ANDERSON: Well, I would point out  
6 that I think your point is well taken, Mr. the  
7 McKenzie; and the Federal Rules specifically  
8 provide that you're entitled to maintain the  
9 originals in your possession, and if Mr. Welsh  
10 wants to identify them in the course of these  
11 proceedings, the Rules provide that he should  
12 make a copy of them and that you should be  
13 entitled under this subpoena to maintain  
14 possession.

15 MR. WELSH: Well, I believe we have an  
16 understanding in that regard already; that we  
17 have agreed to furnish Mr. McKenzie with copies  
18 of these logbooks which were marked previously;  
19 and we intended, although it hasn't been stated  
20 specifically, that we would also furnish him with  
21 copies as soon as we can have them made of the  
22 books that are being marked at this time.

23 I know we haven't requested your  
24 approval or continuance of such agreement, Mr.

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1 McKenzie; and I apologize for assuming that the  
2 same agreement we had with respect to the other  
3 logbooks would also hold with respect to the ones  
4 we're marking now. Are you agreeable that we do  
5 mark these books now and furnish you with copies,  
6 with the understanding that we will return the  
7 originals when the litigation is completed?

8 THE WITNESS: Yes; that satisfies me.

9 I just didn't know the interval that I might be  
10 without them.

11 MR. ANDERSON: I will again ask counsel  
12 to provide us with a copy and show us the same  
13 consideration you're showing Mr. McKenzie; and  
14 again object to the documents and interrogation  
15 about them as irrelevant and immaterial and  
16 voluminous and burdensome and a harassment. I  
17 think if you're going to do this, we're entitled  
18 to have copies.

19 MR. WELSH: At the same time that we  
20 have copies prepared for Mr. McKenzie, Mr.

21 Anderson, we will also order copies for you.

22 MR. ANDERSON: Thank you.

23 MR. WELSH: Would you also like a copy?

24 MR. HERBERT: I would like a copy.

1 Send me your bill with the copy.

2 [Logbook apparently used  
3 from July 20, 1965 to  
4 December 2, 1965, marked  
MIT Deposition Exhibit No.  
53 for identification.]

5 Q Would you now describe the next book which you  
6 brought with you.

7 A Yes. This is a computation book with a label;  
8 on the label, "PDP-1-1 Log." It carries the  
9 number 2365. I've defined that type of number  
10 before, earlier. And the date used is 12/2/65  
11 to April 20, 1966. The 6 is inferred; the last 6  
12 is inferred. It looks like '60; but taken in  
13 this context I would think that it's 1966.

14 Q Would you look at the last page with an entry  
15 and determine if that includes the date.

16 A On Page 116 -- there are a total of 150 pages --  
17 I read the date "Monday 21 March '66."

18 Q And what is the date on the last page?

19 A The date on the next-to-the-last page, 149, is  
20 April 18.

21 Q Are there pages between Page 116 and Page 149  
22 dated consecutively?

23 A On a cursory examination, they appear to be. I  
24 would have to go through them; rather detailed.

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1 MR. WELSH: Would the Reporter please  
2 mark this logbook as Exhibit 54.

3 [Logbook apparently used  
4 from December 2, 1965 to  
5 April 20, 1966, marked MIT  
6 Deposition Exhibit No. 54  
7 for identification.]

8 MR. ANDERSON: I make the same objection.  
9 If any page is to be considered relevant or  
10 referred to, I wish you would identify those pages  
11 or ask the witness about them, so that we can  
12 order the pages that are relevant; if there is  
13 a page or pages relevant.

14 Q Would you now take the next book and describe it,  
15 please.

16 A This is a computation book. It's labeled  
17 "PDP-1 Log." "Log" had been misspelled as "Loog,"  
18 with the second "o" crossed out. It contains the  
19 number 2416. It's used from April 20, 1966 to  
20 18 October 1966; and the same property  
21 designation referenced on Exhibit No. 53.

22 MR. WELSH: Would the Reporter please  
23 mark that logbook as Exhibit 55.

24 [Logbook apparently used  
from April 20, 1966 to  
October 18, 1966, marked  
MIT Deposition Exhibit No.  
55 for identification.]

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1 Q And would you do the same with the last book,  
2 please.

3 A This too is a computation book labeled "PDP-1  
4 Computer," No. 2474, used from 19 October 1966  
5 to 3-29-1967; also containing the label, the  
6 same, "Property of RLE" designation referenced  
7 earlier.

8 Q Were these logbooks, Exhibits 52 through 56,  
9 kept in the same manner as the earlier described  
10 logbooks, Exhibits 4 through 7?

11 A Yes. They were taken from the same drawer where  
12 I brought in the exhibits just mentioned.

13 Q And do they contain information similar to that  
14 of Exhibits 4 through 7?

15 A The same practice discussed earlier was in effect  
16 at that time.

17 Q That is with respect to --

18 A Entries, my thought was; with respect to how were  
19 they used, and how are entries made.

20 Q And that applies to Exhibits 52 through 56?

21 A With respect to usage, the same observations  
22 would apply.

23 MR. WELSH: Would you please mark the  
24 last book, with use from 19 October 1966 to



1 3-29-67, as Exhibit 56.

2 [Logbook apparently used  
3 from October 19, 1966 to  
4 March 29, 1967, marked MIT  
Deposition Exhibit No. 56  
for identification.]

5 MR. WELSH: Off the record.

6 [Discussion off the record.]

7 MR. ANDERSON: Mr. Welsh, it appears  
8 that MIT Deposition Exhibit 52, the red loose-leaf  
9 notebook, has many, many blank pages. Are you  
10 going to copy all of those, too?

11 MR. WELSH: I think it would be unwise  
12 to do so. I would expect to copy, with your  
13 agreement -- unless you wish copies of those  
14 pages -- I would expect to copy only those pages  
15 which have information on them.

16 MR. ANDERSON: Well, that's up to you  
17 what you copy; but it seems ludicrous to copy  
18 any of it unless there's some relevance to it.  
19 It seems superludicrous to copy blank pages.

20 Q Mr. McKenzie, I presume in the copies for you  
21 that I'm making up these books, you do not desire  
22 copies of blank pages; is that correct?

23 A I agree.

24 [Luncheon recess.]

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AFTERNOON SESSIONJOHN ALEXANDER MCKENZIE, ResumedDIRECT EXAMINATION, Continued

BY MR. WELSH:

Q Mr. McKenzie, were you also asked by me to bring another document?

A Yes.

Q Would you tell us what that document is.

A Yes. This is a listing called the directory of the programs filed on a DEC microtape. There is provision in the file system to have a designated name, as well as on the outside label; that is, when you enter the file system by doing a Y comma, you get the name of a tape. This tape is called the demo tape. It is also marked that way on the outside of the spool. The directory is a list by file name of the programs on that tape.

Q Where did you find this, or where was this list, when we asked you to bring it?

A There is a pegboard in Room 26-260 which accommodates many of the commonly used community tapes, we call them; and there is a similar listing of the contents of the other tapes. This was removed from that pegboard, or adjacent to it.

1 Some of these are taped to the adjacent wall.

2 MR. WELSH: Now, we've had some Xerox  
3 copies of that made. I wonder, Mr. Anderson, if  
4 you would agree to stipulate that we may substitute  
5 one of these Xerox copies for the original and  
6 use it with the same force and effect as the  
7 original, so that we can permit Mr. McKenzie to  
8 restore the original to its original location.

9 MR. ANDERSON: I object to the document  
10 as irrelevant, immaterial and not relating to any  
11 issue in the case, and object to the testimony  
12 regarding it; but I'll agree to the substitution  
13 of a copy for the original document, so that Mr.  
14 McKenzie can keep the original.

15 MR. WELSH: Thank you.

16 I now ask the Reporter to mark this copy  
17 as Exhibit 57.

18 [Directory of programs,  
19 marked MIT Deposition  
20 Exhibit No. 57 for identi-  
fication.]

21 Q Referring to Exhibit 57, does this list programs  
22 which are available today for use with the PDP-1  
23 for demonstration purposes?

24 A Yes.

1 Q Do you know who prepared this list?

2 A It was one of the students. Maybe not this list;  
3 but it was one of the students who assembled the  
4 programs on this particular tape which together  
5 make up this list. We update these from time to  
6 time. I did not personally do it.

7 Q Have you had such demonstration tapes available  
8 prior to the present time?

9 A This is the first time they were put together and  
10 specifically called a demonstration tape. In the  
11 past, they were scattered around.

12 Q When were they first put together?

13 A Two or three -- say three; there again with a wide  
14 tolerance -- three years ago, plus or minus a year.

15 Q Referring to this list, I see the word "billiards."

16 A Yes.

17 Q What does that word mean?

18 A There is a billiards game on the machine. I  
19 believe I've never played it. It was one of the  
20 students, I couldn't even tell you who the  
21 student was -- in the course activity, they've  
22 had course projects to display a bouncing ball  
23 bouncing back and forth from one wall to another,  
24 and with gradually diminishing energy. I think

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1 that was extended to this; but this may well have  
 2 come -- I'm sure this hasn't come first; because  
 3 the old bouncing ball dates back many, many years,  
 4 many other computers.

5 Q How many years does it date back? t even put a

6 A I'd say 10 at least; and I think probably earlier.

7 Q Have you actually seen a bouncing ball? re a list,

8 A Yes. Yes. trying to prepare a list before this

9 Q As long as 10 years ago? added it. It hadn't

10 A Well, I can't be that specific; but a long time,  
 11 in that context. then, at least.

12 Q And where did you see the bouncing ball?

13 A On the PDP-1 computer.

14 Q At RLE? AT. ADDING. I object. The question

15 A Yes. The same computer discussed here.

16 Q What display did you see that on? at his when he

17 A It would have had to have been the previously  
 18 referenced DEC Type 30 display. k he testified he's

19 Q Would you describe the billiards game briefly,  
 20 please. AM. WILSON: No. He said he saw it.

21 A Anything I say would be purely speculation. a't

22 Q You have not seen it? at sort of a limit of time

23 A I've seen it. I had little interest in it. I've  
 24 haven't played it. I couldn't talk intelligently

1 about it.

2 Q Do you recall whether it included a ball?

3 A Yes. There would be a ball, and boundaries. I  
4 wouldn't even want to speculate as to which set  
5 of controls were used. I couldn't even put a  
6 time on it. I know that it existed. I probably  
7 wouldn't even have -- if I had to prepare a list,  
8 if I were trying to prepare a list before this  
9 time, I would not have included it. It hadn't  
10 made much impression on me, probably. It was not  
11 a fresh recollection, at least.

12 Q Do you recall the first time when you saw  
13 billiards --  
14 MR. ANDERSON: I object. The question  
15 has been asked and answered.  
16 MR. WELSH: I did not ask him when he  
17 first saw billiards.  
18 MR. ANDERSON: I think he testified he's  
19 not even sure he's seen it.  
20 MR. WELSH: No. He said he saw it.

21 A I can truthfully testify I saw it. I wouldn't  
22 even begin to know what sort of a limit of time  
23 to put on an estimate of when I saw it, you know.  
24 It would be a very broad time frame, and then

1 still pretty much speculation.

2 Q I see the word "runway" on Exhibit 57.

3 A Yes.

4 Q Is that the name of a program for a game to be  
5 played on a PDP-1?

6 A Yes.

7 Q Would you describe that game briefly.

8 A Yes. I recognize this as the work of a student,  
9 Kenneth Okin. It's a game that the player has a  
10 set of controls -- specifically, it was the knobs,  
11 buttons and switches panel which we've earlier  
12 discussed -- and the user is simulating the  
13 action of flying an airplane. I believe you take  
14 off from a runway. I believe you take off from  
15 a runway. You have control for steering the plane.  
16 I believe there is acceleration, speed concept --  
17 that certainly is true; because you need that in  
18 landing. The more interesting thing is that you  
19 try to land this plane, and displayed on the  
20 screen is the runway; and you have the illusion  
21 of height as you're coming in. Of course, the  
22 object is to safely land the plane. If you miss,  
23 there are comments about "You crashed"; and I've



1 think it comments -- I think the comments  
2 describe the degree of success that you had in  
3 crashing, or lack of success is probably a better  
4 choice. I've played it.

5 Q You've actually played it?

6 A Yes. I think it congratulates you if you land  
7 safely, or something.

8 Q What appears on the display?

9 A I think that the display, the presentation of the  
10 display, would be what you would view from the  
11 cockpit window; that concept.

12 Q When did you first become familiar with this  
13 particular game?

14 A This Kenneth Okin is now a doctoral candidate,  
15 and he's been with us since a freshman. It would  
16 be hard to decide just what time he did that.  
17 I'd say four or five years ago; there again with  
18 my customary plus or minus a year, and even that  
19 may not be totally correct.

20 Let me say, there was a research  
21 project earlier done on this machine that I've  
22 referenced earlier simulating the flight of an  
23 F-100; and I think that was sort of the -- I  
24 won't say he used that. I'm sure he didn't have

1 access to the program. But a similar type of  
2 activity had been done. At that time we actually had a -- well,  
3 At that time we actually had a -- well,  
4 we didn't call it a joystick; but a stick, a  
5 single control that would be similar, that you  
6 could -- a single control operation such as a  
7 joystick in a plane gives, if it's still called  
8 that.

9 I won't continue with any of the earlier  
10 effort; but I'm saying there was a like effort  
11 much earlier on the machine. I'll proceed if  
12 it's important.

13 Q Did any of the PDP-1 users prior to the time you  
14 first were aware of this runway game write any  
15 programs for similar games that you know?  
16 I think, MR. ANDERSON: I object. The question  
17 is vague and ambiguous.

18 A Yes. This was conducted as a thesis project,  
19 but it was actually in conjunction with sponsored  
20 research; and it was simulation of flight control.

21 Q Do you recall when that was done?

22 A It was part of a continuing effort in this same  
23 project. They had been doing this sort of thing  
24 back on the Whirlwind computer. They did some

1 of this sort of activity, not with the presentation  
2 as described on the TX-0; and the work continued  
3 on in the first year or two of the operation of  
4 the PDP-1 computer. The student's name is Oleg  
5 Federoff. I've talked to four of the students  
6 who had. I mentioned the research project  
7 connection. This was Mark Connolly's project in  
8 the Electronics Systems Laboratory.

9 Q Was that a sponsored project?

10 A Yes, it was.

11 Q Do you know who the sponsor was?

12 A I can't say for sure.

13 Q Do you have any idea?

14 A It would have been the Department of Defense.

15 They currently have -- the Bureau of Transportation,

16 I think, wasn't that involved in it at that time.

17 I hesitate because they currently, that type of  
18 activity is now Department of Transportation;  
19 and . . .

20 Q Referring again to Exhibit 57, I find the words  
21 "Space War." Is that a current demonstration  
22 program?

23 A That is the one that we now would use.

24 Q Does that have similarities to the Space War

1 program played during the years 1961 through '63?

2 MR. ANDERSON: I object to the question  
3 as leading, vague and indefinite, and ambiguous.

4 A Before testifying here, I anticipated this  
5 question. I've talked to four of the students  
6 who had great interest in Space War --

7 A Yes. But MR. ANDERSON: I object to the witness  
8 giving hearsay testimony. over rather a wide --

9 Q Please continue. or some of them; and all

10 A I asked if, thinking in terms of their work, were  
11 would they agree that the game as played is  
12 basically the same as the first game; and they  
13 said yes. One party specifically described his  
14 work as embellishment of the original game. s.

15 Q Who were those four students? workings of the

16 A The person who used the term "embellishment"  
17 was Winston Edmond; currently at Bolt, Beranek  
18 and Newman. the phone to William Plummer, he said  
19 he wouldn't Carl Howe, currently with MIT. I find  
20 the people Bill Ackerman -- no; I'm sorry. Let me  
21 retract that. Yes, Bill Ackerman. He called me,  
22 actually, on another matter. He's currently  
23 at -- I think it's a small company, American  
24 Systems Engineering, or words to that, something

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1       like that, in Watertown, Massachusetts.

2                   And William Plummer; currently with  
3       BB&N.

4   Q       Were those persons users of the game -- I mean,  
5       of the PP-1 -- prior to the time you talked to  
6       them?

7   A       Yes. But I'd like -- much more than users. They  
8       were hackers of their era, over rather a wide --  
9       each, four years or more of time; and all  
10      together, talking to the four of them, I'd covered  
11      rather a wide span.

12               Each of these fellows had done some  
13      personal work writing Space War. I'm not  
14      thinking in terms of these fellows as players.  
15      They actually knew the inside workings of the  
16      game, and had their own private versions.  
17      Incidentally, I'm violating one; when  
18      I talked on the phone to William Plummer, he said  
19      he wouldn't wish to be bothered with it. I find  
20      the problem to be forthright and still live up to  
21      a specific commitment.

22   Q       Is the Space War program listed on Exhibit 57,  
23       of your own personal knowledge, similar to or  
24       different from the Space War played in 1961, '2

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1 A and '37 sure that I've played it. Probably I have  
2 not for a MR. ANDERSON: Objection on the grounds  
3 that the question is vague and ambiguous.

4 A Yes. If I may answer by qualifying it, it  
5 doesn't have all the options that we've earlier  
6 discussed. Very few options available to the  
7 users. It's pretty much pre-programmed.

8 Appearance-wise, it's the same. on the grounds

9 Q Referring again to Exhibit 57, there appear the  
10 words "road race." Is that a demonstration game  
11 currently being available for the PDP-1? thing

12 A Yes, it is. of. Little knowledge of the game.

13 Q Would you describe briefly what that game consists  
14 of. I've testified before, I'm not sure what the

15 A Yes. Two players race, that is, steer, a couple  
16 of cars around a runway; the runway being an oval,  
17 possibly a figure-eight type track. I guess it's  
18 a figure-eight type track, displayed on the  
19 PDP-1. And you have controls to steer the car.  
20 I forget what the conditions of the game are.  
21 In general terms, that's it.

22 Q Have you observed that game being played?

23 A Yes. Yes. the game?

24 Q Have you played it yourself? of the game?

1 A I'm not sure that I've played it. Probably I have;  
2 not for a long time.

3 Q Do you recall for how long that game has been  
4 played on the PDP-1?

5 A Four or five years at least.

6 Q Do you recall whether the cars have any other  
7 movement than simply following the track?

8 MR. ANDERSON: I object on the grounds  
9 of irrelevance and immateriality; leading.

10 A No. I'm sure the track has a boundary, sidewall.  
11 I'm not sure how crashes or this sort of thing  
12 are simulated. Little knowledge of the game.

13 Q Were there crashes involved in the game?

14 A As I've testified before, I'm not sure what the  
15 conditions of the game are. I think the knobs  
16 are used for steering. Beyond that, I couldn't  
17 say very much about it. I don't have that much  
18 knowledge of the game.

19 Q Do you know who wrote the program?

20 A I can't think offhand. I must know, but I can't  
21 think offhand who it was.

22 Q Do you know who would have knowledge of the  
23 details of the game?

24 A Obviously, many of the students of that era,

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1 four or five years ago; but I wouldn't know for  
2 sure.

3 Q Next on Exhibit 57 I see the word "maize,"  
4 m-a-i-z-e.

5 A Yes.

6 Q Is that also a demonstration game?

7 A Yes, it is.

8 Q Would you describe how that game is played?

9 A Yes. On the PDP-1 display is simulated the  
10 inside of a maze. By that I mean you have the  
11 illusion that you are inside a maze. You see  
12 sidewalls, and a front wall. There is the idea  
13 of depth perception; that is, you can tell  
14 whether it's a long corridor in front of you or  
15 whether you are close up to a wall. Your  
16 position is indicated by a dot.

17 A The objective of the game is to  
18 proceed through that maze, with the dot always  
19 indicating your current position; and you try to  
20 find your way out of the maze. You control your  
21 movement of the dot by turning the knob.  
22 I believe the other knob has an  
23 acceleration control, so that you can control  
24 the speed. The time is kept, and you are scored

1 depending on how much time it takes you to leave.

2 There is one option; that if you're  
3 lost you can flick a switch and there is displayed  
4 on the scope screen a plan view of the maze and  
5 an indication of your current location. I guess --  
6 I don't know what the penalty is when you do that,  
7 whether the game is aborted or not.

8 Q Do you know who wrote the program for that game?

9 A It was written by Raymond Tomlinson, currently at  
10 BB&N.

11 Q Do you know when he first wrote that program?

12 A Ray was with us for a long time. He was with us  
13 for at least four years. I'm not sure at what  
14 point during that four years he wrote it.

15 Q Do you recall the period of four years? What  
16 years were those?

17 A Probably the middle Sixties, middle to the end;  
18 '65 to '70. But there again, that first date is  
19 plus or minus a year; and the last date plus or  
20 minus a year. Somewhere in that time.

21 Q Would it refresh your recollection to look at the  
22 logbooks?

23 A It wouldn't tell me at what time he wrote this  
24 program. It would help me; I could by searching

1 find some time limits on when he was here. He's  
2 been referenced earlier as having written Spass.  
3 But it was here. It was his master's thesis;  
4 and he was here following that in the doctoral  
5 program for a while. *Now I am currently available*

6 Q Are any tapes prepared by him of this program  
7 available in the PDP-1 facility today?

8 A During our visit to Room 26-260 this morning,  
9 two tapes were discovered in a drawer of one of  
10 the files. They're labeled "maze." It's not  
11 clear that they were prepared by Ray Tomlinson.  
12 It was a good program. It's been used. It's  
13 one of the better demonstration programs. It's  
14 been kept around. *personally played that game.*

15 Q Referring to Exhibit 57, I see the word "airport."  
16 Is that another demonstration game currently  
17 available for the PDP-1 computer at RLE?

18 A *There are* MR. ANDERSON: Same objection;  
19 irrelevant, immaterial.

20 A I'm not really sure what the distinction is  
21 between "runway" and "airport." Certainly  
22 different programs, because they're different-  
23 length blocks; but I think I testified clearly  
24 about the runway program. Maybe my testimony at

1           that time should have been airport. I do not  
2           know the difference. It's not customary for me  
3           to play with these tapes.

4    Q       I see on Exhibit 57 also the word "Ping-Pong."  
5           Is that a demonstration game currently available  
6           for the PDP-1 at RLE?

7    Q       MR. ANDERSON: Same objection.

8    A       Yes, it is.

9    Q       Could you describe that game?

10   A       There again, using a display, we have a  
11           presentation of a Ping-Pong table; and the  
12           operator turns knobs -- I believe it's the  
13           knobs -- to simulate batting the ball back and  
14           forth. I haven't personally played that game.

15   Q       Have you seen it played?

16   A       Yes. It was written by one of the students.

17   Q       Are there one or two players?

18   A       There are two players.

19   Q       Do they move -- wrote the program?

20   A       The ball moves back and forth between both sides  
21           of the table, both ends of the table, across it;  
22           simulated net.

23   Q       What causes the ball to move back and forth?

24   A       Governed by the action of the paddle; which in

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1 turn is controlled by the user's interaction with  
2 the computer.

3 Q There are paddle images, then?

4 MR. ANDERSON: I object to the question.  
5 It's leading.

6 A Yes.

7 Q Are there two paddles?

8 A Yes.

9 Q And these are controlled by the players?

10 A Yes.

11 Q Does each player control one paddle?

12 A Yes.

13 Q What type of movement is the player able to give  
14 to each paddle?

15 A I don't know the amount of degree.

16 Q Is it only a straight-line movement, or can he  
17 move it in different directions?

18 A I couldn't tell. I haven't used it.

19 Q Do you know who wrote the program?

20 A No. It was one of the students who wasn't with  
21 us very long.

22 Q Do you remember --

23 A No. He was not one of the, quote, well-known  
24 hackers.

1 Q Do you know when the program was first available  
2 for use with the PDP-1?

3 A It was within the last four or five years.

4 Q Do you know of anyone who would know who wrote the  
5 program or had anything to do with it?

6 A No, because I can't tie down any affiliation of  
7 one student. It may even have been a special  
8 project. Some things come about as a special  
9 project in the course activity, rather than doing  
10 a prescribed task. You're allowed to have credit  
11 for doing something on your own. Some of these  
12 things come about in that way, by a person who  
13 is not with us except for one term; and his  
14 connection is more with the academic staff than  
15 with me.

16 Q Do you know whether the Ping-Pong game was a  
17 demonstration at any open house or parents'  
18 weekend?

19 A It has been available within the last years that  
20 we have had an open house. I cannot say for sure  
21 that it was used at an open house.

22 Q Is the demonstration tape itself dated, or is  
23 there any way to determine what its date is?

24 A The demonstration tape is just things that have

1        been gathered together; and these things were  
2        independently available in our collection, on a  
3        wide range of tapes. This just meant that you  
4        didn't have to sort out and sort the program from  
5        one of many tapes. This was the first time that  
6        they were put together on one tape.

7        Q        Are there any records that would show when these  
8        programs were compiled and put onto the magnetic  
9        tape?

10       A        No. There's no documentation on this. It's not  
11       printed. It's just something, if it's good, it  
12       lies around; and there are many, many more that  
13       we've had and they've disappeared. For some  
14       reason, the students have liked this and kept it  
15       around. It's not one that I would ever have  
16       picked up if I were giving the demonstration.

17       Q        Do you know whether the listings of any of these  
18       programs give any information on the date?

19       A        It would be purely speculative. Some of the users  
20       are a little bit more formal, and might put a  
21       date on. Others wouldn't.

22       MR. WELSH: That completes my direct  
23       examination.

24       MR. HERBERT: Before you start, I'd

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1 like one or two questions.

2 MR. WELSH: I'm sorry. Excuse me.

3 CROSS-EXAMINATION

4 BY MR. HERBERT:

5 Q Along the same line, with respect to these  
6 programs on Exhibit 57, I think maybe Mr. Welsh  
7 has already asked; but with respect to the  
8 variations, is there anyone, a professor or staff  
9 member, that you can think of that might give us  
10 a lead as to, first of all, who wrote the  
11 individual programs, and secondly when?

12 A No.

13 Q Is there --

14 A Excuse me. I referenced that some of it might  
15 have been done in a course project. Professor  
16 Samuel Mason ran the course for two or three years.  
17 He did sometimes allow them the latitude of  
18 presenting special projects. Unfortunately, he  
19 died a few years ago.

20 Q What was the name of that course?

21 A It's had several names; one time, 6.283, and  
22 other times 6.273. It was a variously titled  
23 program in small digital computers, descriptive;  
24 that sort of description. It's not currently

1 like one or two questions.

2 MR. WELSH: I'm sorry. Excuse me.

3 CROSS-EXAMINATION

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6 programs on Exhibit 57, I think maybe Mr. Welsh  
7 has already asked; but with respect to the  
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15 have been done in a course project. Professor  
16 Samuel Mason ran the course for two or three years.  
17 He did sometimes allow them the latitude of  
18 presenting special projects. Unfortunately, he  
19 died a few years ago.

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21 A It's had several names; one time, 6.283, and  
22 other times 6.273. It was a variously titled  
23 program in small digital computers, descriptive;  
24 that sort of description. It's not currently

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1 being offered.

2 Q Besides Professor Mason, who else can you recall  
3 that handled that class?

4 A I'd have to name some -- there again, it's very  
5 difficult to distinguish, you know. That was an  
6 outgrowth of many, many courses. You'd have to  
7 go back on which courses used the PDP-1. But  
8 they didn't all use it to the same degree.

9 And Professor Francis Lee taught the  
10 course at one time. L-e-e.

11 Q I'm sorry. I didn't get the spelling.

12 A L-e-e.

13 William Henke, at that time a professor,  
14 taught it one session. Professor Donald Troxel  
15 taught it more recently. But this work would not  
16 have been done under him.

17 But this documentation wouldn't stay  
18 around. You know, as a matter of fact, it would  
19 be the teaching assistant who would grade it; and  
20 then it would be thrown back in the pile and  
21 returned to the user. Nothing of that nature  
22 would be kept.

23 Q How many teaching assistants would we be talking  
24 about in this period?

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1 A Twenty-four. And beyond that, lab assistants,  
2 who baby-sat the students at the computer. It  
3 becomes rapidly . . .

4 Q What specific department?

5 A Electrical Engineering. I'm sorry.

6 Q Electrical Engineering Department?

7 A Yes. Course 6.

8 Q Do you know whether the various items listed on  
9 Exhibit 57 were compiled on the microtape from  
10 punch tape or from earlier magnetic tape?

11 A From earlier magnetic tape. You know, it would  
12 have been, in that era. We haven't used punch  
13 paper tape for a long time.

14 Q How long?

15 A Since we got the microtapes; 1965, '68.

16 Q Do you keep the original microtapes as you do  
17 the punched tape; or do you reuse it?

18 MR. ANDERSON: I object. There's no  
19 evidence that they keep all punch tapes, which is  
20 what the question implies.

21 A In our tour of the facility this morning, or  
22 possibly it was last night, I indicated a drawer  
23 in a cabinet that was filled with DEC tapes; and  
24 these were students' personal tapes, where they

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1 kept their work, students who have since left.  
2 with MR. HERBERT: Thank you. I have nothing  
3 else.

4 THE WITNESS: May I make a statement  
5 before -- are we still continuing?

6 MR. ANDERSON: Sure; we're still  
7 continuing.

8 THE WITNESS: If it will help any, the  
9 billiards I think would be the one exception that  
10 might have been in association with a course the  
11 activity; and that's purely speculation. All of  
12 the others I'm rather certain were done  
13 independently as a hack, the way we've been  
14 talking.

15 Q (By Mr. Herbert) Would that be Course 6.283 or  
16 6.273?

17 A Yes, during that era.

18 Q Do you recall which professor might have been  
19 involved at that time?

20 A If I had one guess, I'd say Professor Mason, as  
21 I earlier testified; deceased.

22 CROSS-EXAMINATION, Continued

23 BY MR. ANDERSON:

24 Q Mr. McKenzie, there has been testimony about

1 various types of tapes; and I'm not clear in my  
2 mind with respect to what some of the words mean.

3 A Yes; with You referred to, first, binary tapes.

4 Is a binary tape a record of a program, as you  
5 use the term?

6 A Yes. That is, we think of it as a machine  
7 language tape. That is a reflection or an  
8 indication of the ones and zeros; and a person  
9 can read through that tape and find -- and does  
10 read the binary representations as stored in the  
11 computer.

12 Q Then is a binary tape synonymous with a machine  
13 language tape?

14 A I have used it that way in my testimony.

15 Q Is it your understanding that that is a truth,  
16 a definition, in the computer business?

17 A Yes. Around our facility it would be called,  
18 possibly called, machine language; but yes, that's  
19 commonly accepted.

20 Q You've also referred to a source language tape;  
21 and as I understand it, that differs from a binary  
22 language tape or binary tape.

23 A Yes, it does.

24 Q And is a source language tape a tape which could

1 be used directly to program or to put a program  
2 into the PDP-1 in 1962?

3 A Yes; with the reservation that the machine would  
4 not understand it. It would require that you  
5 have an assembly program in the machine to  
6 convert the source language tape to a machine  
7 language tape. The reason that I stayed away from  
8 binary is that I always feel that I have to  
9 define computer words when I use them; and  
10 sometimes I've tried to choose others.

11 Q You say that to use a source language tape in the  
12 PDP-1 in 1962 required an initial employment of  
13 an assembler program to put the source language  
14 tape into binary form; is that correct?

15 A That's correct. Before, the machine would not  
16 understand it directly. It needs this interpre-  
17 tation. It needs the interpretation of an  
18 assembler program.

19 Q In 1962, did MIT have an assembler program to  
20 convert source language tapes to binary tapes for  
21 use in the PDP-1?

22 A Yes. The one that was used in that era was terms  
23 Macro.

24 Q The term "English version" or "English language

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1 Q tape" has also been used. I noted one as we were  
2 over in Room 260. What is an English version

3 A tape? It was the other way around. The alpha

4 A English and source could be used interchangeably.

5 You might also see references on some of these

6 tapes with an alpha. That meant alphanumeric.

7 These terms are interchangeable. Probably source  
8 language would be more textbook style.

9 Q So that "source language tape" is the same as an  
10 English version tape, is the same as an alpha or  
11 an alphanumeric tape; is that correct?

12 A Yes, sir. And further, this is something that  
13 could be listed on a Flexowriter; providing the  
14 codes were compatible.

15 Q Am I correct, then, that a binary or machine  
16 language tape could not be listed on a Flexowriter?

17 A You're correct.

18 Q The term "symbolic tapes" also appears in some  
19 of the documents. What is a symbolic language  
20 tape?

21 A That is a source language.

22 Q That is the same as the source language tape or

23 an alphanumeric tape or an English language tape?

24 A That is used in our installation.

1 Q Did MIT receive the Macro assembler program from  
2 DEC?

3 A No; it was the other way around. The Macro  
4 program had originally been written on the TX-0  
5 computer by Professor Dennis. It was in use on  
6 the TX-0 computer at the time the PDP-1 was  
7 delivered. It was recoded for the PDP-1 by the  
8 students referenced in that era, and was accepted  
9 by DEC as their standard assembler tape.

10 A These three At that time, DEC had no programming  
11 department. They had subcontracted; they had a  
12 subcontract for a party to write an assembler  
13 called Decal; and our Macro came up before Decal  
14 was finished. Decal had been advertised to have  
15 more features, but the features had not been  
16 implemented. There was a version of Decal  
17 available; but not all the linkage features that  
18 were advertised. Macro, at one time, was superior  
19 to -- the working version of Macro was superior  
20 to the working version of Decal.

21 Q Were the instruction codes for the TX-0 the same  
22 as the instruction codes for the PDP-1?

23 A No similarity.

24 I'm sorry. There would be an add

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1 instruction and things like that; but they were  
2 not compatible, if that's the word. Most of the  
3 symbols used were different.

4 Q Referring to the various tapes that have been  
5 identified in the last three days during your  
6 deposition, Exhibits 9-1, 9-2 and 9-3 you  
7 identified as something that came from your files.  
8 Are those binary tapes or are they source language  
9 tapes?

10 A These three exhibits are source language tapes.

11 Q Am I correct, then, that those three exhibits  
12 could not be played through a tape reader and  
13 used to directly program the PDP-1 without --

14 A You are correct.

15 Q Yes.

16 Have you in preparing to testify here  
17 attempted to program the PDP-1 from Exhibits 9-1,  
18 9-2 or 9-3?

19 A No.

20 Q Have you attempted to prepare a binary program  
21 tape from Exhibits 9-1, 9-2 or 9-3?

22 A No. Since changes have been made to the order  
23 code, I'd expect that I'd find something there  
24 that the current assembler would reject. There

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1 would have to be some minor patches made in order  
2 to play those particular tapes; not play, but to  
3 convert those particular tapes so that they could  
4 be used to play a game.

5 Q So if I understand it, then, there is no equipment  
6 now in Rooms 260 or 248 which could be used to  
7 translate Exhibits 9-1, 9-2 and 9-3 into a usable  
8 binary tape?

9 A That's right. There are some instructions there  
10 that wouldn't be known about. For instance, the  
11 IOT 11 previously testified to is not available  
12 now for the student-constructed control boxes.  
13 These programs would have to be patched.

14 Q Do you have documents in Room 260 or 248 from  
15 which you could do the necessary patching to  
16 generate an assembler program that would generate  
17 a usable binary tape from Exhibits 9-1, 9-2 or  
18 9-3?

19 A Yes. The assembler program itself is compatible.  
20 We would have to make some changes in the source  
21 language tapes.

22 Q And how would you know what changes to make? How  
23 do you know what changes to make in order that you  
24 could convert these source language tapes, 9-1,

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1 9-2 and 9-3, into usable binary tapes?

2 A It would be a combination of trial-and-error  
3 approach. I might first try to assemble it and  
4 see which instructions it objected to. If it did  
5 assemble, it probably wouldn't play.

6 Then I might try to find, by using a  
7 debugger program, where it was caught up in a  
8 loop; and it would be a procedure.

9 I happen to know from personal knowledge  
10 that I should go in and substitute a knobs,  
11 buttons and switches -- not knobs; but a read  
12 buttons instruction and place the IOT-11. But,  
13 for a person who didn't know, it's, as I say,  
14 a trial-and-error approach. It would be a little  
15 debugging program, a little bit of debugging of  
16 that program.

17 Q Now, in debugging it, would the steps be to first  
18 make a binary tape from the source language tape?

19 A It would be a combination of both. If you could  
20 get as far as getting a binary tape out, that  
21 would be fine. It may be that there is something  
22 in here now that's not currently defined.  
23 Remember, this English version contains, for  
24 instance, TYI. TYI as currently defined is not

1 what it was then; and we've changed definitions  
2 along the way. This is what I'm trying to say.

3 Q Can you say that you personally have ever used  
4 Exhibits 9-1, 9-2 and 9-3 to program the PDP-1?

5 A I'm sure that I would never have gone to that  
6 step. If indeed I did pick up a copy of Space War  
7 at that time, I would have picked up the binary  
8 program. At that particular time, I think I  
9 still considered it the property of the students,  
10 previously mentioned; and any inquiries or  
11 interest in it I would attempt to pass to the  
12 students. There was always one of them around,  
13 and it was their game.

14 Q When you have taken the source language tapes  
15 such as 9-1, 9-2 and 9-3 and tried to convert  
16 them into binary tapes and tried to debug them  
17 and generate usable binary tapes, would they be  
18 usable in the PDP-1 machine as it stands today  
19 or as it stood in 1962?

20 A If it passed the assembler program, it would be  
21 a usable tape. The assembler program would  
22 reject. For instance, I am sure from my testimony  
23 as I recall it, I think we talked about the  
24 installation of the hardware multiply-divide

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1 somewhere about January of 1963. In these tapes,  
2 we have seen and have testimony to the effect  
3 that there was a multiply step in there; the  
4 so-called BB&N multiply routine.

5 Q And if I -- The current-day assembler would not  
6 know about MUS, multiply step. Do you recall that?

7 Q So that if you used the current-day assembler,  
8 you would get a binary tape, if debugged the way  
9 you've described, that would be usable currently,  
10 but not on the PDP as it existed prior to January  
11 of '63? Is there any issue there?

12 A That's right. There is this lack of compatibility.  
13 And you have to modify things to suit current  
14 conditions or previous conditions back and forth.  
15 A binary tape that would work today would not  
16 have worked in '62, and vice versa.

17 Q Now, you did testify as I recall about the  
18 hardware that was obtained, I think of BB&N's  
19 design, to add a multiply-divide capability to  
20 the PDP-1. Large-scale effort through '68, '69.

21 A I think it wasn't quite that way. The BB&N was  
22 a software implementation of a multiply.

23 Q Yes. It was to be an evolving situation, with

24 A And the hardware multiplier I talked about was a

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1 DEC option. period of time from roughly '63

2 Q That eliminated the need for the BE&N subroutine;  
3 is that correct? implemented, and the same hardware

4 A Exactly. usable throughout for assembly?

5 Q And if I recall, I think you said that hardware  
6 option cost roughly \$10,000. Do you recall that?

7 A Yes, it did. That was put in for the simulation  
8 of the F-100 that we've previously discussed; and  
9 paid by that group, I believe, paid for by that  
10 group. I seem to recall it was never paid for.

11 Q There was some hassle there. correct-a-i-ly?

12 Q I think you said there was another significant  
13 modification in the PDP-1 in Room 260 when the  
14 drum was added; is that correct? started at this

15 A Yes. That was the first step in implementing the  
16 time-sharing system -- the first step in the  
17 large-scale modifications which evolved over a  
18 period of, I guess we started talking about the  
19 drum in the end of '63; and it continued on  
20 rather a large-scale effort through '68, '69.

21 Q The time-sharing system came up, but continued  
22 to be improved. It came up early, but it

23 Q continued to be an evolving situation, with  
24 A improvements. to late 1969's.

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- 1 Q During this period of time from roughly '63  
2 through the end of '68 or '69, when the time  
3 sharing was being implemented, was the same Macro  
4 program usable throughout for assembly?
- 5 A It wasn't used throughout. I think I've testified  
6 earlier that there were several assembler programs  
7 used at various times. I mentioned Possibly;  
8 Certainly, that's currently used.
- 9 Q Certainly?
- 10 A Certainly.
- 11 Q Spelled just the way it sounds; C-e-r-t-a-i-n-l-y?
- 12 A Yes.
- 13 Q Certainly was the name of a program?
- 14 A It's another assembler program generated at this  
15 installation.
- 16 Q Did that replace the Macro assembler program?
- 17 A Yes, it did.
- 18 Q So that the Macro became obsolete at that point?
- 19 A Not necessarily obsolete, but superseded by  
20 something better. It had more features.
- 21 Q And approximately when was that?
- 22 A Sometime middle to late 1960's.
- 23 Q Excuse me. When?
- 24 A Sometime middle to late 1960's.

1        ~~Something~~ When I say "obsolete," may be it would  
2        object to a -- you know, conceptually, it's good.  
3        There may have been interim changes of a few  
4        instructions. At some point, we redefined the  
5        halt instruction and used it for something else;  
6        so that where the program would previously reach  
7        a halt, it would have gone off and started  
8        rotating things around. But, you know, changes  
9        like that would be rather minimal.

10    Q        Was there any other interim assembler program  
11        between Macro and Certainly that was significant  
12        enough to have a separate name?

13    A        I testified that there was one; there was an  
14        assembler called Possible.

15    Q        And "Possible," in quotes, came between Certainly  
16        and Macro?

17    A        There was one, there was another -- and I think I  
18        listed it in earlier testimony, but I did not  
19        within the last five minutes -- Midas, M-i-d-a-s.  
20        That too was carried from the TX-0; and Midas  
21        would have followed Macro.

22        Decal was available with Macro, and was  
23        probably used by a few students -- not students;  
24        some users, especially if they were taking

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1 something to possibly BB&N or somewhere.

2 Q Taking the source language tapes, Exhibits 9-1,  
3 9-2 and 9-3, as I understand it, one could  
4 generate a binary language tape by using the  
5 Macro assembler program and those tapes, 9-1,  
6 9-2 and 9-3, according to your testimony; is that  
7 right?

8 A That's the way it would have been done at the  
9 dates indicated on there.

10 Q That's if the dates are correct; is that right?

11 A Yes, right.

12 Q Now, taking those same tapes, that if the dates  
13 are correct could have been used with Macro,  
14 could they have been used with Midas and gotten  
15 the same binary tape out; or would that not work?

16 A If Midas accepted it, the binary tape would have  
17 been the same. There may have been some subtle  
18 difference between Midas and Macro; but in  
19 general, Midas would have been a little bit more  
20 forgiving. It wouldn't have worked the other way  
21 around. Midas allowed six-bit symbols; Macro  
22 allowed three. So there would have been a  
23 problem. Midas probably would have been happy  
24 with these tapes. But I can't say for sure.

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1 There could have been a problem.

2 Q If these tapes, Exhibits 9-1, 9-2 and 9-3, were  
3 put through an assembler process with Possibly  
4 as the assembler, what would be produced, if  
5 anything, at the output?

6 A I think I should have said earlier that each  
7 assembler has a symbol table of symbols that it  
8 recognizes. If the symbols on the source  
9 language tapes, 9-1, 9-2 and 9-3, were in  
10 agreement with the symbol table contained within  
11 any assembler, it probably -- it's quite clear  
12 that it would work; given the other conditions  
13 on symbol length and this sort of thing.

14 Q Do you know with respect to Exhibits 9-1, 9-2  
15 and 9-3 specifically which assembler programs  
16 if any would work and produce a usable binary  
17 tape?

18 A The one in effect in 1962 --

19 Q Without regard to the dates, seeing you're not  
20 certain of when those dates were.

21 A I understand. But I was going to try to qualify  
22 it in my answer. The one in effect in 1962 would  
23 certainly take care of tapes of that era; and it's  
24 dependent on what times we changed the -- and I

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1 say, changed the order code. We didn't do  
2 wholesale changes; but as we redefined instructions  
3 along the way, which other assemblers would work.  
4 And there again, the assembler itself changed to  
5 keep current with conditions.

6 A No. So you have to qualify which assembler  
7 of a particular date -- the assembler program  
8 continued to be updated as they were used. It's  
9 not easy to pin down these things.

10 Q All right. Then my question is: can you state  
11 now what assembler program would produce usable  
12 binary tapes from Exhibits 9-1, 9-2 and 9-3;

13 without regard for any assumptions about what  
14 the pencil dates mean on them?

15 A Without knowing the date, I couldn't respond to  
16 that. There would be no . . .

17 Q With respect to MIT Deposition Exhibit 11, is that  
18 a binary tape or a source language tape?

19 A This is a source language tape.

20 Q Without giving any regard to the pencilled date  
21 on there, if there is one, but just from the tape,  
22 can you state what if any assembler program would  
23 produce a usable binary tape?

24 A No. see the listing from which this binary tape

1 Q With respect to Exhibit 12, is that a binary tape  
2 or a source language tape?

3 A This is a binary tape.

4 Q Have you attempted to take Exhibit 12 and program  
5 it into any computer recently?

6 A No.

7 Q Have you ever, to the best of your knowledge,  
8 taken that specific tape, Exhibit 12, and tried  
9 to put it into any computer as a program?

10 A I could not specify that I picked up that  
11 particular tape and tried to read it into the  
12 computer.

13 Q Can you say whether that tape, Exhibit 12, could  
14 be placed on the tape reader on the PDP-1 today  
15 and used to successfully program the PDP-1 to do  
16 anything?

17 A It could be read into the computer. It might  
18 work; it might not. It's possible that it would.  
19 If this were using the test word switches,  
20 possibly it would work. I could not say for sure.  
21 Looking at the tape, I couldn't judge. I would  
22 have to see the listing. I could make a better  
23 judgment -- well, this is a binary; so I'd have  
24 to see the listing from which this binary tape

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1 was prepared.

2 Q Is it possible to prepare a listing from  
3 Exhibit 12?

4 A There are programs that work in the inverse order  
5 from -- there have been programs written to try  
6 to take a binary and go backwards. There is no  
7 program like that that I could put my hands on.  
8 It has been done some places.

9 Q So far as you know today, Exhibit 12 cannot be  
10 converted back or written back into a source  
11 language tape with any equipment or program  
12 available in your facilities?

13 A By reading the holes and taking Exhibit No. 49,  
14 a person could very tediously work backwards and  
15 develop the source language.

16 Q The complete source language tape could be  
17 developed that way?

18 A Maybe not as written in the source language; but  
19 you could at least follow it.

20 For instance, I testified about Macro  
21 instructions defining a whole set. This time,  
22 it wouldn't look like the source; because before,  
23 when it called a Macro, you would have to put in  
24 all of the expanded setup there -- not setup,

1 that's not right -- the expanded list.

2 Q And to do that, one would have to know whether  
3 it was Macro or one of the other assembler  
4 programs, like Certainly or Possible, that was  
5 used?

6 A No. The important thing here is the order code,  
7 the instruction code; and that's not peculiar  
8 to Macro, or Midas, to any assembler. A great  
9 deal of effort -- and whether you did it, it  
10 would not be very -- once you went back and saw  
11 the source language, it would not be very obvious  
12 what the program did. You would not have any of  
13 the comments which are done. It would all be in  
14 absolute addressing, you know.  
15 If we refer to Exhibit 9-1-A, that  
16 listing, that has --

17 Q I place before you Exhibit 9-1-A.

18 A That is what I will testify to as having, on  
19 Page 4 -- we've referenced this page earlier --  
20 the left-hand column has symbols. The first one  
21 I find is "CSX comma." That's referred to as a  
22 symbolic address. So that when anyone is trying  
23 to reference this location, the instruction would  
24 say "Add CSX" or "Go to CSX."

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1       Q       When we work backwards from the exhibit  
2       we've been discussing, you wouldn't have all this.  
3       You would have all absolute addresses; and it  
4       would be a very cumbersome type of thing, not  
5       very readable. But depending on definition, it  
6       could be a source language tape. Nothing like --  
7       but not like the original source language tape;  
8       but having more -- having the same purpose, same  
9       object, but not the same ease of reading. today.

10       But I know It would be sort of a hybrid thing.  
11       You wouldn't think of it as a source language  
12       tape, with the relative -- absolute addresses.

13       It would be a . . . tape reader code was used for

14       Q       Mr. McKenzie, if we took Exhibit 12, the binary  
15       tape, and put it on the PDP-1 today in Room 260,  
16       what would be the result? Would it be a usable  
17       program? through the step, multiply step by

18       A       That's -- I'm not sure. Possibly. We might win,  
19       we might lose. I'm not sure. I mean, we. It's  
20       a toss of a coin, as far as I'm concerned. re

21       Q       You don't know whether it would be usable to  
22       program for Space War on the PDP-1 at the present  
23       time or not? , I'm not sure whether they actually

24       A       That's right. I'm not sure. that they

1 Q What factors in the present circumstances of the  
2 machine raise those doubts in your mind?

3 A I'm constrained now in my answer; because I can't  
4 think -- I can't accept the dates. If I'm  
5 allowed to accept the date on the machine for  
6 this one, on the tape for this one answer, that  
7 would indicate to me that it might be the test  
8 word switches for the user input. If that were  
9 true, the test word switches are available today.  
10 But I know there is another problem. That is  
11 something -- again, if I'm allowed to accept the  
12 date, we get back to the old problem of the  
13 multiply. If the same order code was used for  
14 the multiply step as is used for the multiply,  
15 when we reach the multiply step, we're performing  
16 a high-speed multiplication; and then we'll  
17 proceed down through the step, multiply step by  
18 step, digit multiplication; and we'll certainly  
19 have a confusion of data.

20 Q That's because of the switch to the hardware  
21 multiply-divide in 1963?

22 A Yes.

23 Now, I'm not sure whether they actually  
24 use the multiply step or whether they just

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1 A simulated, without using MUS.

2 Q Now, you're referring to the printout -- for word,

3 A Right.

4 Q -- 9-2-A; which relates to different tapes? the

5 A I'm actually looking at Exhibit 9-1-A; and this  
6 is back again to the area previously testified to,  
7 the BB&N multiply subroutine.

8 that time Well, here I see the instruction

9 "Repeat 21 times MUS." The problem revolves

10 around what, how, MUS was defined at this time.

11 If it had a unique definition, then we might be

12 all right. If it has the same definition as the

13 current hardware multiply, we would perform the

14 current hardware multiply; but we would also have

15 run through all these steps, and it's not clear

16 what would happen. But it wouldn't be -- well,

17 I'm sure things would be -- it would be quite a

18 scramble, I would expect.

19 Q Now, you did refer at Page 4 of Exhibit 9-1-A, re.

20 I believe -- the time, and we'd have to see how many

21 A That's right. through the loop. It could not be

22 -- to that MUS -- tion. But the information is

23 A Yes; multiply step. worked out and determined

24 Q -- step; and you said "Repeat 21 times."

1 A Yes. I think I talked yesterday about this.  
2 This is what I termed, for lack of a better word,  
3 the brute force way to have to perform a  
4 multiplication; and the sort of thing that the  
5 hardware multiply does for you in hardware --  
6 that is, does these 21 steps.

7 Q How much time was consumed for those 21 steps at  
8 that time, if you know?

9 A It would be -- let me work backwards. The high-  
10 speed multiply-divide, depending on the number  
11 of ones and zeros, has a time scale on the order  
12 of 20, 25 microseconds. If you're willing to  
13 take ballpark figures, this would be at least  
14 10 times as long, and maybe even much greater  
15 than that. We could go through and list all  
16 these steps; and depending whether they are one-  
17 cycle instructions, which require five micro-  
18 seconds, or two-cycle instructions which require  
19 10 microseconds, come up with an absolute figure.  
20 It would take time, and we'd have to see how many  
21 times it went through the loop. It could not be  
22 done with observation. But the information is  
23 there, and could be worked out and determined  
24 very accurately.

1 Q Mr. McKenzie, I was asking you about using the  
2 binary tape, Exhibit 12; and you indicated that  
3 that would depend on several factors, and then  
4 you switched over to a discussion of Exhibits 9-1  
5 and 9-1-A.

6 Do you know of your own knowledge of  
7 any relationship between Exhibits 9-1, 9-2 and  
8 9-3; and Exhibit 12?

9 A No.

10 Q You don't know that one was made from the other,  
11 or -- a problem as to whether I'm allowed to

12 A Oh, no.

13 Q -- or vice versa? punchout. That does allow for

14 A No.

15 Q Is Exhibit 13 also a binary tape?

16 A Yes, it is.

17 Q And with respect to Exhibit 13, can you say  
18 whether or not that could be played or put in as  
19 a program into the PDP-1 today?

20 A I think my observations about Exhibit 12 would  
21 also reflect my thoughts on Exhibit 13.

22 Q I will place before you Exhibit 16. Is that also  
23 a binary tape?

24 A Yes, it is.

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1 Q And would your observations with respect to  
2 Exhibit 16 be the same as they've been with  
3 respect to Exhibits 12 and 13?

4 A Yes. Disregarding dates, you mean?

5 Q Yes.  
6 And I'll ask you the same question with  
7 respect to Exhibit 18. Would your observations  
8 with respect to the utilization of that tape on a  
9 PDP-1 be the same as with respect to Exhibits 12,  
10 13 and 16?

11 A I have a problem now whether I'm allowed to  
12 recognize the fact that there are knobs and  
13 buttons and field punchout. That does allow me  
14 to put limits on it, apart from the date.

15 Q Do you know of your own knowledge whether that  
16 tape has knobs and buttons on it, or whether  
17 that's just a --

18 A I couldn't, I can't tell by looking at it, if I  
19 could not see the front page.

20 Q All right. Then first assuming that the writing  
21 isn't there, can you tell? Is your answer the  
22 same as with respect to Exhibits 12, 13 and 16,  
23 that --

24 MR. WELSH: Counsel --

1 Q -- that it cannot be used on the current PDP-1,  
2 as far as you know?

3 MR. WELSH: Counsel, I object to the  
4 question. I'm not sure it's clear now what his  
5 answer was with respect to Exhibit 12. There  
6 were a lot of questions with respect to that  
7 exhibit; and you're now lumping 13, 16 and 18,  
8 and I don't know what his answer with respect to  
9 those, what answer you are referring to in your  
10 question. I object to the question as indefinite.

11 Q (By Mr. Anderson) Mr. Welsh's position is  
12 probably well taken, Mr. McKenzie; and I certainly  
13 want you to be clear. I want to establish whether you can tell  
14 from the punched pattern on Exhibit 18, which I  
15 understand is a binary tape, whether that could  
16 now be programmed into the PDP-1 and get any  
17 useful program in that way.

18 A Well, since my testimony on Exhibit 18, I'm  
19 confused now as to what I'm allowed to accept.  
20 I talked on Exhibits 11, 12, 13 and 16 assuming  
21 that they were Space War; but if I'm not allowed  
22 to assume that much, then I can't say, you know.  
23 Obviously, it's just another piece of paper.  
24

1 Now, I thought at first I could only  
2 rule out dates. Now I'm ruling out -- now, if I  
3 have to rule out knobs and buttons and field  
4 punchout, I guess I need a further question as to  
5 what I'm allowed to assume and what I can't  
6 assume.

7 MR. WELSH: Mr. Anderson, I object to  
8 this line of questioning because it involves  
9 hypothetical questions and calls for the  
10 speculation of the witness; and I would like to  
11 reserve objections as to all of the questions of  
12 this type, where you're making assumptions. The  
13 witness just indicated he has testified previously  
14 with respect to these tapes relying on the  
15 information contained on the tapes themselves;  
16 and the questions that you are asking now are in  
17 effect hypothetical questions.

18 If you're willing to accept him as an  
19 expert on the PDP-1 computer, then perhaps the  
20 questions are not out of order; but as they have  
21 been posed I object to them and this general line  
22 for assumptions made with respect to these.

23 MR. ANDERSON: Mr. Welsh, this general  
24 line is necessitated because you persisted and

1 insisted in asking this witness to read into the  
2 record longhand entries that he said weren't his,  
3 and he didn't know when they were made; and  
4 therefore I think your position is not well taken.

5 Q (By Mr. Anderson) Mr. McKenzie, if I understand  
6 your testimony, then, from the punches on the  
7 various tapes you cannot ascertain whether they're  
8 Space War or when they were made or what  
9 assembler program would be necessary to go from  
10 binary to source language; is that true?

11 A With a qualification, now. You recall yesterday  
12 we looked at the punched title. Some of these  
13 had a title punch; some didn't. I'm not sure  
14 which ones. They would have to be inspected.  
15 I did testify to some of these. This one did not.  
16 Some binary tapes had the title punch.  
17 My testimony, while I'm looking at the  
18 tapes, my testimony on Exhibits 11, 12, 13 and 16,  
19 I was personally not confused in my mind at that  
20 time. I was operating under the assumption that  
21 they were Space War; all of my testimony is  
22 correct. The only thing that caused me trouble  
23 was when I couldn't utilize the knobs-buttons  
24 reference; which I guess really is my question.

1 Could I use that or not?

2 Q Tell me, with respect to Exhibit 13 -- excuse me;  
3 that's not the right number.

4 A The question -- I interrupted you.

5 Q Tell me with respect to Exhibit 18 how your  
6 answer differs if 18 does in fact include knobs  
7 and buttons, versus if it does not include knobs  
8 and buttons.

9 Q I'm sorry. MR. WELSH: I object to the question  
10 again as being indefinite as to what is meant by  
11 "the answer would be different." What answer?

12 MR. ANDERSON: The answer that he said  
13 he could give; precisely.

14 A This would have a much better chance of working.

15 We know, if we're willing to accept the

16 information, assume the information on the front  
17 page, that at this time we had the high-speed  
18 multiply-divide. We wouldn't have that problem.

19 Q We know that we have an input which is still on  
20 the machine, and which will still work.

21 A That is -- I couldn't tell you which assembler this  
22 was prepared -- from the chances, if we were to  
23 step through these, the more recent date that we  
24 were willing to assume, the better becomes the

1 chance that it will work. This one, I would think,  
2 probably would work.

3 Q And you're referring to 18?

4 A There again, I'm wondering what it might have used  
5 for a clock. But I think, if I had to put my  
6 money out, I would say this one would work.

7 I had an earlier question that I didn't  
8 finish.

9 Q I'm sorry.

10 A You asked if I could tell from the holes in the  
11 tapes. I guess I have to be consistent and say  
12 that yesterday I testified to reading the title  
13 punch on some of these tapes.

14 Q And am I correct that you did not put the title  
15 punch on there?

16 A That's something that's put on by the assembler.  
17 That is a punch of the first line of the source,  
18 program listing.

19 Q And am I correct that you did not run this tape,  
20 Exhibit 12, to the best of your knowledge?

21 A That is correct.

22 Q Now, with respect to Exhibit 18, and the notation  
23 on the top sheet concerning knobs and buttons,  
24 you said that you thought that would have a good

1 chance of working. Is that on the assumption  
2 that it worked when it was first done on the  
3 machine as it then stood?

4 A Oh, yes.

5 Q So if it didn't work then, it would not work now;  
6 is that correct?

7 A It was relatively, you know -- when we started  
8 talking about Exhibit 11, relative to Exhibit 11,  
9 it would have a far better chance.

10 Q MR. WELSH: Excuse me, Mr. Anderson.  
11 The witness has been testifying for over an hour  
12 and a half now. Would this be a good time to  
13 take a break?

14 Q MR. ANDERSON: Sure; any time for a  
15 break.

16 A If I'm all [Recess.]

17 Q Mr. McKenzie, I now place before you Exhibit 19,  
18 which is a binary form of program tape; is that  
19 correct?

20 A Yes, that is correct.

21 Q Have you ever played or attempted to program a  
22 PDP-1 with that particular tape, Exhibit 19?

23 A I could not say that I had used this specific  
24 tape.



1 Q Do you know whether or not, of your own knowledge,  
2 that tape was ever operative to program a PDP-1  
3 to play Space War?

4 A I do not know.

5 Q Do you know whether that particular tape can be  
6 read into the PDP-1 in Room 260 today and obtain  
7 an operable program in the machine?

8 A I will respond to this in somewhat the same  
9 fashion I responded to Exhibit 18.

10 Q With respect to Exhibit 14, that is what you've  
11 referred to as a source language tape; is that  
12 correct?

13 A That is correct.

14 Q Do you know what assembler program is required  
15 to convert that into a binary tape?

16 A If I'm allowed to reference the splicing of the  
17 tape which we've testified to before as a time  
18 reference, then I would say -- I know that Macro  
19 was in effect; and the time that we discussed at  
20 length when the tape was introduced.

21 Q Did you personally splice the tape?

22 A I did not.

23 Q Did you see it done?

24 A I did not see it done.

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1 Q With respect to Exhibit 15-1 and Exhibit 15-2,  
2 are they also source language tapes?

3 A Yes, they are.

4 Q And I'll place before you also Exhibit 15-3.

5 A Is that a source language tape?

6 A Yes, it is.

7 Q Do you know what assembler program was used --  
8 or would produce a binary tape from Exhibits 15-1,  
9 15-2 and 15-3, from your own knowledge?

10 A If I have to discount the date that I see written  
11 on the front page, the front fold -- I've used  
12 "page" when I mean "fold" -- then I cannot tell.

13 Q And you did not make the date entry; is that  
14 correct?

15 A That is correct.

16 Q Did you see the date entry made?

17 A If I did, I don't remember. It's unlikely.  
18 There is a one-in-a-million chance that I did,  
19 but it's very unlikely.

20 Q It's my understanding of your testimony that all  
21 of the tapes -- Exhibits 9, 11, 12, 13, 14 and 15--  
22 were confiscated on an occasion when you were  
23 instructed to restrict the use of the PDP-1 to  
24 other than Space War and games. Is that correct?

1 A Yes.

2 Q And it's my understanding that they were all  
3 confiscated at the same time, approximately, in  
4 one purge; is that correct?

5 A Yes. Everything we could put our hands onto,  
6 anything around, we put out of sight.

7 Q And is it also correct that you don't know when  
8 that purge occurred, that confiscation?

9 A I'm not sure whether I put a time limit on that  
10 or not; whether you're asking -- I know within  
11 broad limits. I don't know . . . Shall I try?

12 Q Yes. Restate the broad limits. I'm not sure I  
13 remember them.

14 A I'm not sure what I tried yesterday. But 1964,  
15 '69.

16 Q All right.

17 And if I understood your testimony,  
18 since you learned of the interest of these tapes  
19 by the parties to this litigation, you've kept  
20 them locked up; is that correct? Or do I  
21 misunderstand what you said the other day?

22 A I said that I kept them locked up. At that time,  
23 I was only referring to the logbooks. I brought  
24 the tapes here in response to the attachment on

1 the subpoena.

2 Q Attachment A to the subpoena?

3 A Yes.

4 Q They were not locked up, then; only the logbooks  
5 were locked up in the last few months?

6 A Actually, I found the box that contained the  
7 tapes in the same file cabinet as the logbooks;  
8 and I testified earlier that that cabinet is  
9 open during the day, but formally locked at night.

10 Q Mr. McKenzie, are you a computer programmer?

11 A I do not consider myself a computer programmer.

12 I do some programming, mainly diagnostic  
13 programming, and patch some programs. I do not  
14 consider myself a programmer. I do some.

15 Q Was your level of programming activity in 1963  
16 and '64 about the same as you just said it is  
17 now?

18 A Yes. I could not have programmed Space War.

19 Q I noticed that the PDP-1 in Room 260 is  
20 frequently referred to as the PDP-1-X. What does  
21 the X refer to?

22 A During the time that we were doing the large-scale  
23 modifications, somewhere along the way we started  
24 talking about the experimental machine; and for

1 some reason we started tying X to the title block  
2 on the drawings. There was not too much  
3 significance to it. At that time, it was just  
4 different from any other PDP-1; and programs  
5 generated on the PDP-1 could not be taken  
6 elsewhere and run.

7 Q Was that period of extensive modifications the  
8 period from '63 to '69 when you added the drum  
9 and made it a time-sharing system?

10 A Yes.  
11 The more significant thing, though,  
12 in regard to programs and tapes was the changes  
13 in the order code. We have a more extensive  
14 order code on the PDP-1 that we've been discussing  
15 all this time, and referred to also as the PDP-1-X.  
16 We have instructions there that are not on a  
17 standard PDP-1.

18 Q When were the changes in the order code made?

19 A Well, all during that time. This was piecemeal.  
20 This was not over quite as wide a range of time.  
21 It would tend toward the earlier limits, earlier  
22 time, of the time frame that I mentioned.

23 Q When we were in Room 260 today, I asked you if  
24 you had a book on the Type 30 display, or a

1 circuit diagram; and I believe you said you had  
2 both. Is that correct?

3 A That is correct.

4 Q And have you produced them here now?

5 A I have.

6 MR. ANDERSON: I would like to mark  
7 both as exhibits.

8 Q And I understand you are still using the CRT  
9 Type 30 display book. Is that correct?

10 A That is correct. It is still applicable for our  
11 display.

12 MR. ANDERSON: Can we handle that  
13 document in the same manner as the others, Mr.  
14 Santa and Mr. Welsh? Can we agree to have it  
15 marked as MIT Deposition Exhibit 58, and agree to  
16 substitute a copy to be prepared by the micro-  
17 reproduction group at MIT? This; and the I will

18 MR. WELSH: Yes.

19 MR. ANDERSON: All right. The reporter

20 MR. WELSH: You mean the same as the  
21 manual?

22 MR. ANDERSON: The same as the manual.

23 MR. WELSH: That's the only one that  
24 we've handled in that way.

1 MR. ANDERSON: Yes. We'll treat it the  
2 same as the manual; seeing that Mr. McKenzie  
3 would like it back.

4 MR. WELSH: And we'd like a copy, and  
5 Mr. Herbert would too.  
6 [Discussion off the record.]

7 MR. ANDERSON: Let the record show that  
8 we will not mark the original; that Mr. Young  
9 will at some time mark the copy of Exhibit 58.

10 [Type 30 display book reserved as MIT Deposition  
11 Likewise, the 10 left Exhibit No. 58 for identi-  
12 fication.]

13 Q (By Mr. Anderson) Mr. McKenzie, with respect to  
14 the circuit diagram of the Type 30 display, is it  
15 my understanding that that is a document that  
16 you're willing to release for the time being?

17 A Yes. I have a duplicate of this; and this I will  
18 place at your disposal.

19 MR. ANDERSON: I'll have the Reporter  
20 mark that as MIT Deposition Exhibit 59.

21 [Type 30 display circuit diagram, marked MIT Deposi-  
22 tion Exhibit No. 59 for  
23 identification.]

24 Q Mr. McKenzie, will you look at Exhibit 59, please;



1 and open it up and describe just generally what  
2 is shown on the various portions of that diagram.

3 A Yes. In my earlier testimony in response how  
4 does the information get from the computer to the  
5 display, I think I mentioned that the digital  
6 information is transferred from the computer;  
7 10 bits of information come from the high order  
8 end -- by "high order end" I mean the left-hand  
9 end -- of the accumulator. They determine the  
10 X coordinate of the point that's to be displayed.  
11 Likewise, the 10 leftmost bits of the in-out  
12 register are transferred to the display; and they  
13 are used to set up the address of the Y coordinate  
14 of the point which is about to be displayed.

15 Q And you've been pointing to a portion of Exhibit  
16 59 across the lower center which is marked X0  
17 through X9, for the accumulator inputs; and  
18 Y0 through Y9 for nine IO inputs; is that correct?

19 A Yes. When I've discussed the Y coordinate, I  
20 specifically discussed the IO inputs which lie  
21 beyond, below, the rectangles marked Y0 through  
22 Y9. That is for the Y axis. about this, we  
23 talked about The same applies for the X axis; the  
24 rectangles labeled X0 through X9 accept the

1 previously referenced 10 bits from the AC.

2 The circuit flow passes up the drawing  
3 to the digital-to-analog converter. The  
4 information for the X axis -- that is, X0 through  
5 X9 -- comes out near the top of the drawing on  
6 two lines labeled left and right. That is, the  
7 X axis is the horizontal or left-right component.  
8 That is the analog output. It is fed from here  
9 to the horizontal deflection yoke, at the yokes  
10 of the computer, of the CRT. This is termed the  
11 push-pull deflection. One of them is being  
12 pushed and the other is being pulled. I don't  
13 know why I have to define that out. I'll leave  
14 it at that point at this time.

15 The same statement applies to the right-  
16 hand half of the page, the Y axis. The analog  
17 signal for this comes out on the two lines  
18 labeled A and B. It's really up and down. The  
19 lettering is put on in a fashion that it's not  
20 very clear. The "up" should be tied in with the  
21 A side, I would hope.

22 I testified earlier about this. We  
23 talked about the IOT 07 instruction, which is a  
24 display instruction. Every time that is of

1       executed, a pulse is shown on the lower left-hand  
2       edge of the computer, labeled Dippy.

3       Q     DPY?

4       A     DPY. It comes over from the computer; and that  
5       pulse is used to transfer the contents of the  
6       accumulator into the X register, and the contents  
7       of the IO into the IO register. And programmed  
8       within that pulse is a previous pulse, which is  
9       an earlier pulse, which clears the previous  
10      contents of these registers. The Dippy pulse  
11      also starts a delay, which in this drawing is  
12      labeled 35 microseconds. It was my testimony  
13      earlier that that was 40 microseconds. I think  
14      of it as my machine. That time is necessary to  
15      allow the deflection to be set up. That is, these  
16      deflection yokes are coils of wire, and there is  
17      inductance -- that is, there is a delay in  
18      passing the current through here and reaching  
19      the static situation.

20     Q     Is that 40 microseconds necessary to stabilize  
21     before you illuminate the screen?

22     A     Yes. I am leading to that; because if they time  
23     out of the 35 or 40 microseconds, we start a  
24     10-microsecond delay. During the interval of

1 that 10 microseconds, the CRT beam is conducting  
2 and the screen is illuminated. I say the screen;  
3 I mean the reference point is illuminated.

4 Q So that just one point on the screen is  
5 illuminated?

6 A Yes. This is a point-by-point display. And to  
7 tie the whole thing together, this X and Y is  
8 the address of one specific point on the raster  
9 which we have previously talked about as 1,024  
10 by 1,024.

11 Q What determines the sequence in which those  
12 points are addressed by the PDP-1 and Type 30  
13 display?

14 A That is determined by the program. Before you  
15 reach the sequence in your program where you  
16 wish to issue your Dippy instruction, you  
17 previously set up the AC and the IO registers.

18 Q If I understand it, then, it requires 50 micro-  
19 seconds of time in the Type 30 display to  
20 generate one point; is that correct?

21 A That is correct. Now, I have to make my usual  
22 qualification. The IOT 07 instruction, the  
23 Dippy instruction used interchangeably, has an  
24 option that if you do not wish to waste that

1 40 microseconds, you can have the instruction  
2 complete in two cycles -- that is, 10 microseconds --  
3 and start to set up the IO and AC registers for  
4 the next point. That is, the display point by  
5 point still takes 50 microseconds; but you can  
6 do some setup within that.

7 There is the other option in the instruction, and specifically this option is  
8 governed by whether you use a 72 or 73 order code--  
9 am I still consistent? All this?

10 Q Yes.

11 A So it's not as time-consuming in sequencing,  
12 through this as what it might first appear to be.  
13 But it is true that each point, you certainly  
14 cannot display any faster than every 50 micro-  
15 seconds; but you can do some setting up in  
16 between. And in the machine, for some period of  
17 time, we have built in a synchronizer; so that  
18 in your program you can execute these instructions  
19 sooner. You do not have to worry about program  
20 timing; the instruction is held up by the  
21 synchronizer. That was not available at the time  
22 I'm talking about the standard PDP-1; that is  
23 something later in time.

1 Q Do you know when that synchronizer feature was  
2 added?

3 A Sometime in the middle 1960's, plus or minus a  
4 year or two.

5 Q But even with the synchronizer, it still took  
6 50 microseconds minimum per spot of illumination?

7 A That is exactly correct. The only thing is, I'm  
8 trying to tie it down a little bit more from a  
9 programmer's point of view.

10 Q If I understand you, you're saying that it is  
11 possible in the PDP-1 to do some computation  
12 while the display is being set up during the 50  
13 microseconds for the next spot, to save  
14 computation time?

15 A Yes. The programmer has the option, when he  
16 writes the display instructions in the program,  
17 about whether he wishes the computer to wait for  
18 a return pulse or go on, go ahead. With the  
19 synchronizer, you don't have to worry about the  
20 program timing; because if your program starts  
21 to execute the second Dippy instruction and the  
22 display is not ready, you're held up by a  
23 hardware synchronizer.  
24 As it was first done, it was necessary

1 for the programmer to count instructions, that  
2 knowing that each cycle of instruction requires  
3 five microseconds; in program time, the 50-  
4 microsecond interval.

5 Q You mentioned the substantial number of  
6 instructions -- I think you said 20 or 25 -- for  
7 a single multiplication subroutine in Exhibit  
8 9-1-A.

9 Do you know what the period allowed  
10 for computation was in the program which you've  
11 partially listed in Exhibit 9-1-A, the total?

12 A No. I referenced the 21 multiply steps.  
13 However, for each of those steps -- a lot of  
14 this code is setup time. It's not enough just  
15 to do the step. There is setup and testing.  
16 And it says 21 steps; but remember, we have 34  
17 bits plus two signs. And after that, I thought  
18 that I was pretty optimistic in saying -- I think  
19 I probably inferred that the length of this, what  
20 I've termed brute force, was just 21 times  
21 a multiply step instruction. It was much greater  
22 than that. It would have been very time-consuming.

23 Q Now, when the Type 30 display has illuminated  
24 a spot, is there some way in which the display



1 communicates back to the PDP-1 to tell it that  
2 it's ready for the next completed computation  
3 and new information for the next spot?

4 A I've just said that the user has the option, in  
5 writing his instructions, as to whether to wait  
6 for the completion pulse referenced on the  
7 drawing as "Dippy done," or going on and doing  
8 the program timing which we've just been  
9 discussing.

10 I called it "Dippy done." Let me  
11 correct it. On the drawing, it's called "Disp  
12 done."

13 Q I would like you to refer to Exhibit 58, if you  
14 will, the book entitled "CRT 30A Display," and  
15 state if that includes either the same circuit  
16 diagram as Exhibit 59 or a representative of that  
17 circuit diagram in the form of a block diagram  
18 or the like.

19 A It does not include a reduced version of Exhibit  
20 59; although I'm sure that at one time -- I know  
21 that at one time it did. It is not in this book.  
22 It is the one which is most commonly used; must  
23 have just been pulled out at some time.

24 Q What is Exhibit 58, the book that you're looking

1 through?

2 A May I correct my last statement? There is a two-  
3 page -- there is a fold-out page here. Looking  
4 at the one side, it has a circuit diagram for  
5 the components within the display housing; that  
6 is, the CRT housing. However, on the other side,  
7 I've found what at first glance would appear to  
8 be a reduced version of Exhibit 59.

9 Q What is the book, Exhibit 58?

10 A I'm referring to the DEC instruction manual  
11 labeled "Precision CRT Display," slash -- which  
12 is a row of dots -- "Type 30A."

13 Q And does that book, Exhibit 58, relate to the  
14 Type 30A CRT display which is in Room 260 of  
15 Building 26, do you know?

16 A I have used this book to service the machine in  
17 Room 26-260.

18 Q And to the best of your knowledge, is Exhibit 59  
19 a circuit diagram of the Type 30A CRT display in  
20 Room 260?

21 A Yes, it is. I have used this type of print for  
22 servicing.

23 Q Mr. McKenzie, in your testimony, I believe you  
24 referred to a loop and speeding up a loop. Do

1 you recall referring to a loop in your testimony?

2 A I'm not sure of which connection, but I'm sure  
3 I must have.

4 Q Does the term "loop" have some meaning in your  
5 business?

6 A Yes.

7 Q What is the meaning of that term?

8 A Well, while a program is being executed, there  
9 are always sections within the program which are  
10 looped through many times while the program is  
11 being executed; usually, being looped through  
12 in order to set up some particular pattern for a  
13 test, or to possibly -- at the time I mentioned  
14 it -- to perform a multiplication. This is 9-2-A,  
15 something that is not gone through once in the  
16 sequence of events; but where the program wouldn't  
17 execution would sit for a period of time, running  
18 around until the exit from it is set up. And  
19 the exit is in the form of a test, has something  
20 happened; and the test, of course, is always  
21 binary.  
22 Q In Exhibit 9-2-A at Page 4, there is reference  
23 to -- I guess it's, yes, Page 4 -- to a step in  
24 this listing that you talked about which says

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1 "End of comparison loop." Can you state what  
2 that refers to?

3 A I can say what my impression is from reading the  
4 comment. It would take considerable time. If I  
5 may, if my explanation is what does the comment  
6 mean to me, this is a reference to the previous  
7 test that I've said; that it is executing this  
8 loop until some condition is satisfied. At this  
9 time, it is going to drop through and continue  
10 to execute the next instruction.

11 Q From your knowledge of Space War, were there  
12 comparison loops utilized in the program, if you  
13 know?

14 A Until I produced this listing, this Exhibit 9-2-A,  
15 I have never considered the Space War program.  
16 If I can talk in the broader context, I couldn't  
17 imagine a program of that nature without having  
18 loops. But I have never considered it, or never  
19 thought specifically about the Space War program  
20 as a program.

21 Q I see; all right. Then I gather you could not  
22 state of your own knowledge what is referred to  
23 in the Space War program as a comparison loop?  
24 From your own knowledge?

1 A No. Somebody would have to go through the code  
2 and work back and see what they're trying to test.

3 Q Now, there is also reference at Page 4 of  
4 Exhibit 9-2-A to a "display loop."

5 Again, from your personal knowledge of  
6 Space War or the Space War program, do you know  
7 what is being referred to as a display loop?

8 A Well, there are two ways I can approach this.

9 I can take several hours and start going down

10 through all this; or I can just make a quick  
11 judgment that, for instance, in displaying the  
12 outline of a spaceship.

13 Q No; you misunderstand. I just want to know if  
14 you know, basically, if you know of your own  
15 knowledge or familiarity with the program, what's  
16 meant by that in this printout, this listing.

17 A Can I say what it means to me, but not necessarily  
18 what it implied to -- well, how is it generally,  
19 how would it generally be interpreted? May I  
20 respond to that?

21 Q All right.

22 A That is customary when you're plotting something--  
23 and I think we can use the outline of a spaceship.  
24 You would go through a loop as you generate the

1 points for the outline of the ship, and then  
2 drop through. And you might call on this same  
3 time loop for another outline, some other object,  
4 and feed a different type of information. This  
5 might be called on, this is sort of a service  
6 area that can be fed different bits -- not bits;  
7 I'm using this in a different connotation now --  
8 different pieces of information. I can't look  
9 ahead and tell you; but this depends whether it's  
10 a subroutine. If it's a subroutine, it is called  
11 many times within the program.

12 Something that has a loop in it may  
13 well be a subroutine. It may be part of the main  
14 program.

15 Q All right. There is just one other reference in  
16 Exhibit 9-2-A; and I would like to know if you  
17 have any personal knowledge or recollection in  
18 this regard.

19 There is reference at Page 5 to a  
20 listing "Use up rest of time of main loop." Do  
21 you know, in any Space War program that you were  
22 familiar with or used or played with, what was  
23 meant by "the main loop"?

24 A Well, it's customary in a program to have a main

1 part of the program; and the program would sit  
2 most of the time, using my definition of "sit,"  
3 and goes off sometimes to a subroutine, executes  
4 a subroutine, but usually returns to the main  
5 loop. That is where the program is being  
6 executed. I say most of the time. Actually,  
7 when you take in all the subroutines, most of the  
8 time could be in the subroutine. But that is  
9 sort of the logic of the computer. The logic of  
10 the program is being executed.

11 And better, I guess, the best way to  
12 tie it down is to say the main program is the  
13 control part of the program.

14 Q You testified, I think, on direct that the PDP-1  
15 in Room 260 was a gift from DEC to MIT. Is that  
16 correct?

17 A That's correct.

18 Q Do you know what the list price or approximate  
19 list price of the PDP-1 was in 1961?

20 A I understood that it was \$100,000.

21 Q Do you know what the list price was on the Type 30  
22 display that came later?

23 A I believe that was \$10,000.

24 Q Was the drum that was added a purchased item, or



1 was that a gift, do you know?  
2 A The drum that we have discussed -- there have  
3 been two drums. The drum discussed was \$30,000.  
4 It was purchased; it was \$30,000.

5 Q Were there any other peripherals used on the  
6 PDP-1 in the period 1961-63? There were several  
7 typewriters, I guess.

8 A We had two typewriters available, one of which  
9 was a spare. There was provision for using only  
10 one typewriter at that time.

11 Q There was only one input to the PDP-1 for a  
12 typewriter; is that correct?

13 A That is correct, yes. I think the question, I  
14 would say several -- what other peripherals,  
15 there was a reader, the punch.

16 Q This would be the reader that would put the punch  
17 tape information into the program?

18 A Yes.

19 Q Or into the accumulator, excuse me; into the  
20 memory?

21 A Yes; all right. But it's actually by the machine,  
22 so you were correct.

23 Q Was the punched tape reader an extra, then; and  
24 how much did that cost?

1 A That was delivered with the machine. It was part  
2 of the standard PDP-1.

3 Q As the PDP-1 was delivered to MIT in about 1961,  
4 how many bits of memory did it have, do you know;  
5 or how many words, whatever?

6 A Words is an easier number to come by. It had  
7 4,096 words of core memory.

8 Q That was in a stack of cores; is that correct?

9 A Yes.

10 Q Do you recall how many bits in each word?

11 A Yes. The machine has an 18-bit word length.

12 Q That's true in the memory as well as in the  
13 accumulator and IO?

14 A Yes, that's correct.

15 Q Was the memory of the PDP-1 in Room 260 expanded  
16 beyond 4,096 words at any time?

17 A Yes.

18 Q When did that first occur?

19 A It's been done in several phases. Probably the  
20 earliest one, 1964; plus or minus a year.

21 Q And how much memory was added at that time?

22 A We added them in 4,096 increments. I believe we  
23 were given one additional -- if we talk now about  
24 a 4K module as being equivalent to 4,096 words --

1 we were given one additional memory module by  
2 DEC. I think we purchased a second one.

3 And then, at some later time -- this  
4 would have been 1966 -- we added at one time two  
5 Ampex 4K modules of memory.

6 Q Of your personal knowledge, do you know how much  
7 of the memory was employed in playing Space War  
8 at any time?

9 A The initial game certainly only used -- was  
10 limited to no greater than 4,096 words of memory.  
11 I could not personally say whether any of the  
12 users' programs expanded into what I term the  
13 second core or not.

14 Q Do you know whether the users fully utilized the  
15 first 4K memory?

16 A I could not say.

17 Q Or whether that put any limitation on Space War,  
18 the fact that there were only 4K of memory?

19 A I'm sure it was a consideration, but I'm not sure  
20 what limitation it was.

21 Q You testified, I believe, that at certain times,  
22 at least from your knowledge of Space War, there  
23 was a star field. Is that correct?

24 A Yes.

1 Q And I also think you said that the star field  
2 made the game more sluggish.

3 A That's correct.

4 Q Now, what do you mean by "more sluggish"?

5 A That is, the spaceship is less responsive to the  
6 controls. I think at one point I talked about  
7 having control of the clock, that is, the  
8 frequency of the clock; and if you turned it to  
9 the high end, to a high speed, that knob would  
10 become so sensitive that if you started to try  
11 to turn it to change your heading a little bit,  
12 the ship would turn around 180 degrees. And at  
13 the other end, if it were sluggish, which was the  
14 way I used it, before you could take an evasive  
15 action, your opponent could shoot you down.--

16 I don't know if you can talk in terms  
17 of a hot sports car or a hot ship or something.  
18 That's the sort of feel; a difference in the feel  
19 of the game.

20 Q I understand.

21 Now, how did the star field's presence  
22 or absence enter into that sports car response  
23 or lack of it?

24 A The program as it was first played -- and we've

1 discussed the length of time necessary for  
2 multiplications and all that, in connection with  
3 the long discussion we've had this afternoon on  
4 length of time -- the display in each of these  
5 different stars was time-consuming, relatively  
6 time-consuming; and added nothing to the skill  
7 necessary to play the game. That is, thinking  
8 about a skilled player being able to handle a  
9 quick response; versus an unskilled player being  
10 happier with a, quote, sluggish control.

11 Q Then if I understand it, the presence of the star  
12 field forced upon the user a slow clock, in  
13 essence?, 1962. That would have a clock, that

14 A Well, not a slow clock. Well, as the game was  
15 first employed -- not employed; first used -- at  
16 there was no clock. I have been told that at  
17 that time it was just program timing. Well, it  
18 had to be; because there was no clock available.  
19 Q And it was dependent on the time around or through  
20 the program, what the effective response was.  
21 use of 15. As the machine became more powerful,  
22 is the word we use, that was with the higher-  
23 speed multiplication, then you could afford to  
24 have the overhead -- I think is the word I've

1 used -- in your program to display the star field.

2 Q When did the clock first become available?

3 A There was an entry in the log; and I think I  
4 testified, in my notes, that I saw that in-out  
5 rack -- it's Exhibit 8 --

6 Q I place before you a copy of Exhibit 8, or  
7 Exhibit 8.

8 A Yes. I had a reference to what I called  
9 Book 2, but I believe it is Exhibit 5, that there  
10 was a lab modules rack installed in the PDP-1;  
11 and from my notes, Exhibit 8, I indicated it was  
12 March 13, 1962. That would have a clock, that  
13 could have controled; and there was no other  
14 reason for it at that time -- control the rate at  
15 which the frequency with which the knobs were  
16 looked at. (Not knobs, I'm sorry; switches were

17 looked at. that the switch or knob, whatever

18 Q Was the clock solely for use in Space War; or,  
19 did the clock have general applicability in the  
20 use of the PDP-1?

21 A It could have been used for other things. It  
22 caused a sequence break; and I think I testified  
23 a little bit about the sequence break.

1 Q Yes. I think you did; and I think you indicated,  
2 and have again today indicated, that with the  
3 high-speed clock you might actually get a 180-  
4 degree reversal of a spaceship in the time that  
5 you could see a change in the display. Is that  
6 correct? In other words, it would seem to flip  
7 right over through several steps?

8 A Well, I've had to go over and turn it back to  
9 satisfy me; and it was a range that it wasn't  
10 playable, you know. Things would really get out  
11 of control.

12 Q Did the clock determine, as I think you said  
13 yesterday -- did the clock determine the period  
14 at which the position of a switch was sampled  
15 for computation purposes?

16 A It had the effect of doing that. I'm not sure  
17 how it was utilized in the program; but the end  
18 effect was that the switch or knob, whichever  
19 was being used at the time we're talking about,  
20 was more responsive to a higher-frequency clock.

21 Q Am I correct that the 50-microsecond minimum  
22 interval for generating a single spot on the  
23 Type 30 display was independent of that clock;  
24 it was determined by the mechanics of the display



1           itself?   I don't know of anything that was

2   A       Yes.   I don't know of anything that was

3   Q       Mr. McKenzie, are you familiar or have you ever  
4       heard of a portion of MIT, a part of MIT, known  
5       as the Innovations Center?   with the IDP-1 to 1000

6   A       I have read about it, most likely in Tech Talk.

7   Q       What is the Innovations Center?   now a little bit

8   A       I think, my understanding is that there is some  
9       mechanism now where student projects can obtain  
10      some financial assistance; and that anything of  
11      value -- I'm not sure what we mean by "value" --  
12      is developed, and MIT and the students share  
13      some rights or whatever comes out of it. I don't  
14      know if I'm right in that, in my thinking there.

15   Q       Do you know whether that is a separate entity,  
16      a corporation or something, apart from MIT, the  
17      Institute?   I don't know.   I understand the connection

18   A       I don't know.   and the Innovations Center.   Could

19   Q       Have you had any personal dealings with the  
20      Innovations Center with respect to PDP-1 work at  
21      any time?   is some connection between -- oh; All

22   A       I have not; and I don't know of any activity  
23      tied in with the PDP-1.   It could have been done  
24      after somebody left the PDP-1 complex; but to my

1 knowledge, I don't know of anything that was  
2 started on the PDP-1 and has gone that route.

3 Q To the best of your knowledge, has anyone  
4 connected with the Innovations Center ever come  
5 to you or anyone connected with the PDP-1 to look  
6 into Space War work?

7 A Yes. I'll have to start talking now a little bit.

8 In connection with the indication that  
9 I would be subpoenaed to talk about Space War,  
10 I went to the RLE headquarters office,  
11 headquarters a better word, and talked with the  
12 administrative assistant to Professor Zimmerman,  
13 Henry J. Zimmerman, who is the director. Miss  
14 McCarthy is the administrative assistant. I  
15 told her what was happening. Her words were,  
16 "We've got to get in touch with Art Smith."

17 Q Now, I'm not sure I understand the connection  
18 between that and the Innovations Center. Could  
19 you explain that?

20 A All right. I guess I am making the assumption  
21 that there is some connection between -- oh; all  
22 right. Let me go on. I think I have to proceed.

23 He called me back on the phone --

24 Q That's Mr. Zimmerman?

1 A No. I'm sorry.

2 Q Mr. Smith?

3 A The most recent reference, Mr. Smith; called me  
4 back on the phone and said that he'd be out of  
5 town, but would get in touch with me.

6 Within the next day or two, Mr. Robert  
7 Shaw called me and said that he found a note on  
8 his desk from Mr. Smith in regard to Space War,  
9 and said "What is it all about?"

10 I volunteered to come over to his  
11 office. He said "No; let me come over there."

12 Mr. Shaw did come over. We showed him  
13 a demonstration of Space War. At that time, I  
14 broke open the package of logbooks which had  
15 previously -- Exhibits 4 through 7 -- which had  
16 previously been Xeroxed; and we discussed the  
17 subpoena which I had agreed to accept.

18 There was another student in the room  
19 at the time called Robert Price, who was currently  
20 using the machine. There was some discussion  
21 between -- well, Robert Price and Mr. Shaw  
22 recognized each other; and there was some  
23 discussion, that Robert Price as a student had  
24 some, made some inquiries about going through of

1 Mr. Smith's office in regard to some work. I am  
2 inferring from all this that this has some  
3 connection with the Innovations Office. It may  
4 be something apart. That is why I've gone this  
5 long route.

6 Q Is there any other connection that you know of  
7 between Mr. Price and Space War and the  
8 Innovations Office?

9 A There is no connection between Mr. Price and  
10 Space War. This was a long way of getting around,  
11 did I have any connection with the Innovations  
12 Office. If indeed Mr. Robert Smith -- no; Mr.  
13 Robert Shaw is from the Innovations Office, then  
14 I had a connection with him. You said Mr. Price  
15 to the Patent Office. Yes. Mr. Shaw; Mr.  
16 Smith's office. That's the way I thought of it.

17 Q Do you know if there is any relationship between  
18 the Office of Sponsored Programs at MIT and the  
19 Innovations Center?

20 A I didn't know -- I do not know that there is any  
21 Office of Sponsored Programs.

22 Q I think that's the label on the door out here  
23 as we walked in, if I'm not mistaken.

24 A Well, yes. I've testified about the Division of

1 Sponsored Research; and that's still the name  
2 that I think about.

3 Q I see. Is there any connection between the  
4 Division of Sponsored Research, that you know of,  
5 and the Innovations Center?

6 A I do not know. I always thought -- I do not know.

7 This Robert Price I'm talking about,  
8 his work is a thesis; yet he's working on a  
9 project which is sponsored. His part of it is  
10 his thesis. But there is a direct tie. Just  
11 about every thesis is done under the sponsorship  
12 of some group doing sponsored research. I don't  
13 know how you can divorce it.

14 Q I think, if I understood you, you said Mr. Price  
15 to the best of your knowledge has no connection  
16 with Space War.

17 A Oh, that's right.

18 Q Do you know whether the Innovations Center has  
19 had any activity with respect to games having  
20 video displays?

21 A I do not know. I know that at some point -- I do  
22 not know that. I recall that in some meeting  
23 one of the attorneys from the Patent Office,  
24 somewhere along the way in proceeding with this,

1 somebody had said, "Too bad we didn't have the  
2 Innovations Center at that time," or something  
3 like that. This has just been brought out in  
4 passing, about that.

5 Q Do you know who said that?

6 A I couldn't say.

7 Q Or on what occasion?

8 A It might even have been RLE headquarters. It was  
9 on the occasion of me having to testify. It was  
10 within that connection and within the last month  
11 or six weeks.

12 Q Within, say, the last two years, to the best of  
13 your knowledge, has anyone reviewed your  
14 historical documents with respect to Space War  
15 other than Mr. Katz and Mr. Welsh on the occasion  
16 of their visit here, and us in the course of  
17 these proceedings here this week?

18 A No. I had no knowledge of the interest in this  
19 until I was visited by Mr. Welsh.

20 Q Mr. McKenzie, have you ever heard of a company  
21 named Executive Games, Incorporated?

22 A No.

23 Q During your direct testimony, I think you stated  
24 that your paycheck came from RLE at one point in

1 time. Does your paycheck come from Massachusetts  
2 Institute of Technology, or from some portion of  
3 it, or division of it, do you know? In other  
4 words, what's on the check?

5 A I'm on the monthly payroll, paid with an MIT  
6 check. My affiliation is RLE. And at various  
7 times, my salary has been apportioned between  
8 various groups.

9 I think at the time I said that  
10 previously, I said my paycheck from RLE -- has a  
11 part from RLE, and Electronics Systems Lab;  
12 dividing my time. At the time it was divided,  
13 I was administrative with Electronics Systems Lab.

14 Q Do you know if RLE is a separate corporation or  
15 just a division or part of Massachusetts  
16 Institute of Technology?

17 A It's a laboratory of electronics, Electrical  
18 Engineering Department.

19 Q You don't know if it is a separate corporation  
20 or not; or is it not?

21 A It's part of MIT.

22 Q I think perhaps you were asked this question;  
23 but certain of the logbooks that have been  
24 identified, such as Exhibit 53, bear a number,



1 which in the case of Exhibit 53 is 2323. Do you  
2 know what that number, 2323, signifies?

3 A Yes. We requisitioned these notebooks at -- it's  
4 termed the Services Group, who were next door.  
5 They maintained the supply of, well, stationery  
6 supplies.

7 However, when the logbook was issued,  
8 it was assigned a number; and they kept a record  
9 as to who, as to whom the logbook was issued.

10 Q Do they keep an index of all the logs, do you  
11 know, and who they're issued to?

12 A Any time that I've picked up a book, they've done  
13 that. How religiously, I couldn't tell.

14 Q I think you testified that you met with Mr. Welsh  
15 and Mr. Katz some time ago. Do you know when  
16 that was?

17 A I recall that it was a Friday afternoon. They  
18 were in a hurry to get to the airport. And  
19 anticipating that -- well, once it became more  
20 significant, that we would -- that I agreed to  
21 testify, I referenced the time it was by the  
22 shipping paper which accompanied the return of  
23 the Xeroxed exhibits. That was, that put -- I  
24 knew that that came the following week; and would

1 have pinpointed that Friday to the last Friday  
2 in July. I think it's probably the 27th.  
3 Probably could have tied it down if it were a  
4 Friday; but I remember there was this rush, and  
5 I sympathized with them.

6 Q Where did you meet with them, Mr. McKenzie?

7 A In Room 26-260, and 26-248.

8 Q Approximately how long did the meeting last?

9 A They came to me via RLE headquarters. One of  
10 the secretaries called and said "There are some  
11 people interested in Space War." I was very busy  
12 at the time. It turned out it was with this  
13 same student previously mentioned, Robert Price.  
14 I helped him set up his experiment. I said,  
15 "Oh no. Not two more sightseers." I think I was  
16 reluctant to have them. And she said, "No; they  
17 just want to talk about it."  
18 So they came down about 11:30, as I  
19 recall; and we talked until probably 12:30. And  
20 they filled me in on some of the places -- not  
21 places; people they had talked to, and gave me  
22 some confidence that they had a good deal of  
23 knowledge about the game. Nothing that I was  
24 going to say would give them much more knowledge.

1 I think I was hesitant at the start, was my  
2 problem. Once they mentioned -- once they of their  
3 own knowledge mentioned all these names that have  
4 been discussed -- better than that, they were  
5 able to tell me what they were currently doing --  
6 it was evident that they had talked to them, and  
7 had a great deal of knowledge about the game.  
8 And with this large number of references,  
9 it looked as though I was the last one in the  
10 chain; and I agreed to look at the logbooks. I  
11 think their inquiry to me was, they referenced  
12 this sign that I once had, "Space War not  
13 allowed." They said, could I find that; and I  
14 said no, but I might find some reference in the  
15 logbooks. *Smith, discussing my visit with Mr.*  
16 *Robert ...* We started to look through the logbooks.  
17 It came noontime, it was beyond noontime; became  
18 lunch hour. And I said "I have an appointment  
19 with somebody." And we probably broke around  
20 12:45. They said they'd come back after lunch.  
21 I think we met again about two o'clock,  
22 and looked through the balance of the four  
23 logbooks, the first place, as exhibits; carried  
24 them down to the micro -- not micro; to the

1 Graphic Arts Copy Service. And I think we  
2 testified beyond that. That was probably three  
3 to 3:30.

4 Q Had you had any prior knowledge that there was  
5 any interest in Space War with respect to  
6 litigation on games?

7 A That was the first knowledge that I had of the  
8 interest.

9 Q Since that meeting in July, have you had any  
10 occasion to meet with anyone else with respect  
11 to your testimony here, in preparation for it,  
12 up to the time you walked in this room on  
13 Tuesday morning?

14 A I've discussed my telephone conversation with  
15 Mr. Arthur Smith, discussing my visit with Mr.  
16 Robert Shaw; the call and visit that I gave to  
17 him, and the visit that I had in connection with  
18 my question of the broad request of the  
19 attachment. And while we talked that first  
20 Friday afternoon, there were other people in the  
21 room who were well aware of what was going on.  
22 I think that a good part of the time, in the  
23 afternoon at least, I was jumping back and forth  
24 trying to help people; and people knew what, at

1 this time, people knew what was being looked for.  
2 Q Subsequent to that meeting in July, have you  
3 discussed this case with either Mr. Welsh or  
4 Mr. Katz prior to walking in here to begin the  
5 deposition on Tuesday morning?

6 A Yes. I had a call from Mr. Welsh asking if I  
7 would be willing to testify at a hearing. I  
8 guess my first question was, have a deposition  
9 taken -- I think my first question was, do I have  
10 to go to Chicago. No; the question was first,  
11 would I be willing to testify or give a deposition.  
12 At the time, would I be available -- what was the  
13 date -- October 28. I guess one of my questions  
14 was, Would I have to go to Chicago? He said it  
15 would be held locally; and I indicated that I  
16 would be able, would be willing. I don't know  
17 whether I qualified it then that I would have to  
18 check with MIT.

19 However, I immediately did go to RLE  
20 headquarters; and I think again, Mr. Smith,  
21 probably. Anyway -- yes. Mr. Smith was alerted;  
22 because I had contacted him before the deposition,  
23 and he said that somebody would sit in with me.

24 Q Did Mr. Katz or Mr. Welsh at any time show you

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any documents or things during your meeting with them?

A No.

Q What were the names that they gave, to the best of your recollection, that showed their familiarity with Space War?

A They had said that they were going out to DEC to see Alan Kotok that afternoon. They indicated that they had been on the West Coast, and had talked with Peter Samson, Robert Saunders. They indicated they had talked with Professor Minsky, Professor McCarthy. There probably were more, and maybe I have an extra one in there. I've used this group of names many times. They had at least five what I considered good references. They were not coming in cold to me.

As far as these fellows were concerned, I felt that I wasn't really giving away any secrets about the game.

Q Did Mr. Welsh or Mr. Katz at any time say anything to you regarding what the issues were in the case, or what it was they were looking for?

A They indicated that there was some court action -- I don't know whether the word "pending" or what --

1 that there was some court action that would be  
2 coming. I think part of my -- in handling the  
3 logs, you know, that there might be some further  
4 interest in these if things -- well, if things,  
5 it depended how far the action went. It looked  
6 like, I think, I had the impression there was  
7 preliminary court activity at that time; and I  
8 can't use the legal terms. I'm sure I'd make a  
9 mistake.

10 Q Did they give any indication to you of the facts  
11 that they wanted to prove or what they were  
12 trying to establish?

13 A We were talking about Space War at that time.

14 Q Any specific aspect of Space War?

15 A We were looking through the logs with the idea  
16 as to whether, trying to find out via the log-  
17 books when was it first played. That was the  
18 interest that I -- well, there was no misinterpre-  
19 tation. That was the interest. They knew about  
20 Space War. They only wanted to know, when was it  
21 first played.

22 Q Did they ever give any indication of any specific  
23 aspect of Space War that they were interested in?

24 A No. That was not discussed.



1 Q Mr. McKenzie, you have prepared these two listings  
2 Exhibits 9-1-A and 9-2-A. Were you requested by  
3 someone to prepare those?

4 A No. That was in trying to respond to the  
5 attachment, providing certain pieces of material.

6 Q With respect to Exhibit 10, the PDP-1 handbook,  
7 am I correct that that was, according to the code,  
8 printed in October of 1963? I think you explained  
9 their code in your direct testimony.

10 A Yes, it would have been applicable. However, I  
11 remember we had some custom-built in-out transfer  
12 instructions, which I've referenced. But yes;  
13 with that qualification, that's correct.

14 Q Do you know when that PDP-1 handbook, Exhibit 10,  
15 came into your possession?

16 A We requested them in large numbers when we first  
17 started to have course activity on the PDP-1,  
18 which began in the fall of 1962. It was probably,  
19 most likely, one of the lot that came down during  
20 that time. We probably -- we had some of them  
21 available before that time for the users; but  
22 the number of users greatly expanded when we  
23 picked up the course activity.

24 Q What was the last occasion that you know of when

1 you ordered any PDP-1 handbooks; the most recent  
2 one, in other words?

3 A I couldn't answer. Somewhere along the way,  
4 they were not as readily available; and we  
5 started to have Mimeographed instruction sheets  
6 containing the order code and necessary  
7 information here, and that became the handout to  
8 the students, to the users.

9 Q Is it your practice to save all tapes which are  
10 generated for programming the PDP-1 in Room 260?

11 A No.

12 Q Do you now recall why you have preserved the  
13 specific tapes which have been identified with  
14 exhibit numbers here today and the last three  
15 days?

16 A They were recovered from the open files in the  
17 PDP-1 room, so as to discourage further use of  
18 Space War -- and worse than that, further users'  
19 modifications, versions of the game. If it were  
20 not for that occurrence, they would still be in  
21 the file cabinet in the back room, in the same  
22 fashion that there are many games, paper tapes  
23 of games, in the drawers out there.

24 Q I think you testified on direct regarding the

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1 unhappiness of your people with the pink tape;  
2 and you had to get the gray tape for them.

3 When you got the gray tape, did the  
4 users immediately start to use the gray tape?

5 A Yes.

6 Q And what was done with the pink tape that was  
7 still in inventory at that time?

8 A We had hoped, we tried to have some of it used up  
9 on the Flexowriters. However, some of it no  
10 doubt was left around the back room. Nobody  
11 would have taken it of their own volition; yet  
12 I would not have thrown it out.

13 Q You mentioned Richard Howell in your direct. Who  
14 was Richard Howell, or is Richard Howell?

15 A He came to us as a student in freshman year.

16 Q Do you know what period of years he was here?

17 A Extended over a long period of time. He was a  
18 student who was in and out of school, though he  
19 was always with us; and probably we first saw  
20 him in 1964, plus or minus a year.

21 Q That's when you first saw him?

22 A As a user, that is. When I first saw him, it  
23 was as a user.

24 He continued with us, dropped out of

1 School for a while. When he dropped out of  
2 school, he went into the Service, put in time in  
3 Vietnam; came back as a student following service.

4 Q And who is Carl Howe?

5 A He was a student who was with us for a period of  
6 about four years while an undergraduate.

7 Q Starting approximately when, to the best of your  
8 recollection?

9 A He came back -- let's see. He graduated about  
10 1974. I get confused, now, because of the  
11 difference in the academic year. -- But it would  
12 have been four years previous; June of 1970, that  
13 possibly '69.

14 Q You pointed out on your direct examination, I  
15 think, that one of the tapes had a TS on it; and  
16 I think you indicated that meant it was a tape  
17 usable with the PDP-1 when it was adapted for  
18 time-sharing. Is that correct?

19 A Yes.

20 Q Were tapes adapted for use on the PDP-1 with  
21 time-sharing not usable on a standard PDP-1 after  
22 that?

23 A Yes. For instance, if you wanted your program  
24 to reside on, or part of your program to reside

1 on the drum, the instructions to reference the  
2 drum were not standard PDP-1 instructions.

3 Q You also stated in your direct examination that  
4 at some point in time you began preparing  
5 quarterly usage reports on the PDP-1. Do you  
6 recall that?

7 A Yes, I did. I said that.

8 Q Do you know when the first quarterly usage report  
9 was prepared?

10 A There was no significant usage on it that I could  
11 have reported much earlier than -- I would  
12 probably have started to report the quarter that  
13 the course activity started; which would have  
14 been the fourth quarter of 1962.

15 Q Mr. McKenzie, on MIT Deposition Exhibit 23, at  
16 the top of the page, there is a pencil entry of  
17 "Page 37." Is that in your handwriting?

18 A It is.

19 Q Do you know when you made that?

20 A It was since I was subpoenaed, and in response  
21 to the deposition, about bringing all this

22 material.

23 Q Approximately how many hours would you estimate  
24 that you've spent in preparing to testify here

1 in this deposition?

2 A It was an on-again, off-again type of thing.  
3 Maybe, total, six. Six hours, maybe; something  
4 like that.

5 Q At the top of MIT Deposition Exhibit 21 there is  
6 an entry, "Page 28 G." Is that in your hand-  
7 writing?

8 A Yes, it is.

9 Q And when did you make that?

10 A The same references I made with respect to  
11 Exhibit 23 would apply.

12 Q Did you ever discuss with anyone the amount of  
13 time that you should spend in preparing to  
14 testify?

15 A No.

16 Q You testified on direct that the illustration on  
17 Page 39 -- at least this is my recollection, that  
18 your testimony was that that is a photograph.

19 Do you have any way of knowing whether that is a  
20 photograph or a simulation of some sort?

21 A No.

22 Q What was the basis for your stating that it was  
23 a photograph?

24 A I guess I thought it looked like a photograph.

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1 When you ask the question this way, I certainly  
2 cannot state for sure that it is. It could have  
3 been simulated.

4 Q The illustration on Page 39 is a rectangle wider  
5 than it is high, with, apparently, the star field  
6 generally filling the whole area. Is this  
7 illustration typical of the appearance that you  
8 saw on the screen when you saw Space War played?

9 A The star field does fill the whole screen.

10 Q When you say "the whole screen," the screen on  
11 the Type 30 display is round.

12 A I always say "raster." We've gone through this.  
13 My definition; all right. I will correct that  
14 to mean raster.

15 Q And is the display rectangular, as it's shown on  
16 Page 39 of Exhibit 23?

17 A No. I've testified that the raster size, the,  
18 raster, is square.

19 Q At any time, have you seen on the display a lot  
20 pattern of positions such as is illustrated in  
21 the figure on Page 39?

22 A There is some persistence. As a ship is moving,  
23 you can see, I think I testified that depending  
24 on light conditions, it sort of determines what



1 the persistence is.

2 Q And does the persistence of the Type 30 display  
3 give you a plurality of discrete positions of the  
4 spaceship, as shown at Page 39 of Exhibit 23?

5 A Certainly the track is available. Whether it is  
6 quite that -- I would say under some conditions  
7 that -- certainly, when the ship is, every time  
8 the ship is displayed, when you see the ship, the  
9 outline looks right. But there is this persistence.  
10 Whether that's part of the previous location or  
11 not -- you've obviously got me stopped. This is  
12 something I've never considered before. And it  
13 looks realistic.

14 Getting down to detail now, I must back  
15 off.

16 Q As I understand it, the system used in Space War  
17 was that a particular spaceship such, perhaps,  
18 as the lowest one shown at Page 39 of Exhibit 23,  
19 would be drawn in its entirety; and then a lot  
20 of other things would happen, and then at some  
21 later time the system would come back and draw  
22 another little spaceship, perhaps the next one up.  
23 Is that the way the system works?

24 Q That would be program-independent, and possibly

1 changed between programs. The spaceship outline  
2 was generated. Whether you generated it all at  
3 one time or not, we'd have to reference the  
4 program to see.

5 Q Well, how was it done on the programs that are  
6 shown in the tapes, roughly Exhibits 9 through 15  
7 here, do you know?

8 A I haven't examined the programs, no.

9 Q What was the frequency or the periodicity at  
10 which a given spaceship, such as perhaps this  
11 lowest one at Page 39 of Exhibit 23, was redrawn  
12 by the Type 30 display?

13 A I couldn't begin to put a number on that.  
14 Q In time?

15 A No. I never thought -- I'm not familiar enough  
16 with the program to think in terms of it from the  
17 program point of view; and from the point of  
18 view of looking at it and playing it, I never  
19 gave much consideration to it.

20 Q Was it once a second?

21 MR. WELSH: I think he said he didn't  
22 know.

23 Q Well, do you know within a range?

24 A Oh, yes. Obviously, I can put it in a wide range.

1 You know, now I have to go back. I can't respond  
2 without thinking what is a reasonable number;  
3 and I don't think that's the type of answer you  
4 want from me.

5 Q All right.

6  
7 In Exhibit 23 at Page 37, there is  
8 reference to the Hingham Institute. What is the  
9 Hingham Institute?

10 A At the time this paper was given -- and I'm not  
11 sure whether I saw a preprint of this -- but in  
12 that, whether it was in this paper or when we  
13 first knew that -- the first copy of the paper  
14 was passed around the room. When I read that,  
15 I questioned it; and as I recall, the answer was  
16 that Russell lived in Hingham, which is a  
17 community south of Boston.

18 Q Do you know Hugh Wiitanen?

19 A No.

20 Q What display was used with the TX-0 computer?

21 A It carried no number. It was something built at  
22 Lincoln Laboratory, one of a kind, to be put onto  
23 the TX-0. It came down with the TX-0 at the time  
24 testified to.

Q Did it function generally in the way that a CRT 30A

1 type display functioned?

2 A In a general sense. It was smaller; it was a  
3 smaller raster size.

4 Q I think you said three inches square, roughly.

5 A No; I think I said roughly --

6 Q Excuse me.

7 A It was six to seven; and it did not have as many  
8 points. This one has 512 by 512 points.

9 Q Which one?

10 A The TX-0 I'm talking about has 512 by 512 points.

11 Q And what does the Type 30A -- excuse me for  
12 interrupting -- what does the Type 30A have?

13 A I'd earlier testified that that has 1,024 by 1,024.

14 This gets back to the thing I'm leading up to;  
15 that it takes 10 bits to address one axis of the  
16 scope on the PDP-1, and only nine bits to address  
17 one axis of the scope on the TX-0. This meant

18 that the address for both the X and the Y -- the  
19 coordinate could be contained in one word; so  
20 that the word was in the accumulator, rather than  
21 split between two registers.

22 At the time of the TX-0, it was somewhat  
23 faster; maybe 33 microseconds versus 50.

24 Q Was the deflection on the TX-0 magnetic or

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1 electrostatic? in so pulses.

2 A It was electrostatic. for computational circuit

3 Q During your direct examination yesterday, I  
4 A noticed on Exhibits 47 and 48 the rubber stamp  
5 "Reference only, not for production." Do you  
6 know who placed that there?

7 A I know that it's not a stamp that we have. he

8 Q Do you know the significance of that? nothing could

9 A I've seen that on other prints that come from  
10 DEC., gated is gated with or enabled with, in

11 Q Mr. McKenzie, I'd like to place before you  
12 Exhibit 27, MIT Deposition Exhibit 27, which is  
13 labeled "General Control Functioning PDP-1."

14 Q You indicated that there are certain stepdown  
15 currents, I believe, across the top. Can you  
16 state what if anything those currents control?

17 A Yes. My statement I'm sure would have been to  
18 the effect that this is not a counter, but is the  
19 timing chain; and as I recall my testimony, and  
20 what I would say now, is that each event within  
21 the computer happens at the time one of these of  
22 time pulses occurs. So that in between times, the  
23 you're doing setup; and then the transfer, load,  
24 clear, whatever is being done is executed at the

1 time of one of these pulses.

2 Q Are these pulses used for computational control  
3 of some sort?

4 A Yes; computation control, including transfers,  
5 shifting --

6 Q Transfers between registers?

7 A Yes. Everything that takes place within the  
8 machine requires the timing chain. Nothing could  
9 be done. That is, everything, if I may use the  
10 term, gated is gated with or enabled with, in  
11 conjunction with, a time pulse.

12 Q This is in the PDP-1?

13 A Yes.

14 Q Is there anything in Exhibit 27 which determines  
15 the loops about which I asked you questions  
16 earlier?

17 A The timing chain across the top of the page  
18 determines the machine cycle. But the time of  
19 the loops, from my definition, would be the  
20 number of instructions -- well, all right. In  
21 this -- yes, in connection with -- the number of  
22 instructions executed determines the length of the  
23 loop; and the length of instruction is determined  
24 by the number of cycles. The length of the cycle

Doris C. Wong

1 in turn is determined by the timing chain. All  
2 right; it's all consistent.

3 Q Now, am I correct that at least at the beginning  
4 the timing chain and the computations were held  
5 up in the PDP-1 during the display cycle, the  
6 50 microseconds?

7 A I wanted to qualify my statement, and you were  
8 already in the question. Yes; and of course, at  
9 the time the multiply-divide came along, this  
10 same thing held, yes.

11 Q So that all of this computation, at least in the  
12 early stages, was done between the time that was  
13 set aside for the display of a dot?

14 A Let me say that this setup -- by that I mean  
15 getting the address of the next point into the  
16 accumulator and the IO --

17 Q Yes.

18 A All of this would be, yes, this is all part of  
19 the timing chain.

20 I think I've lost the sense of the  
21 question. Maybe you'd better restate it.

22 Q I think you probably answered it. My question  
23 was: were the computations of the data in the  
24 arithmetic section and so forth of the PDP-1



1 held up during the 50 microseconds set aside for  
2 display, and then did it come back and do  
3 computations after that, when you first got the  
4 PDP-1?

5 A

No.

6 Q

Or were they going on simultaneously?

7 A

8 I had testified that you could utilize the in-  
9 between time to set up the next address. This  
10 setting up of the next address might have involved  
11 a computation. It may only have been indexing  
12 the previous address by one point, or something  
like that.

13 Q

14 Do you know whether all of the display was  
15 accomplished sequentially, by displaying first  
16 the first spaceship and then the second spaceship  
17 and then the sun and then the stars and maybe the  
18 torpedoes in a discrete section of time; and then  
a time after that set aside for computation?

19 A

20 I don't know how it was intermixed. In order to  
21 cut down the flicker rate, I think you would want  
22 to intermix it; but I do not know. You would get  
23 a better visual image from a flicker point of  
24 view if you put it -- the way it's done today is  
that you don't index sequential points, but you

1 randomly display points, to further cut down  
2 flicker rate.

3 So in that sense, I do not know from  
4 this program; but the way that it would want to  
5 be done would be an interlace.

6 Q You testified, I think, that the 50 microseconds  
7 required for display were determined by delays  
8 shown in the Type 30 display drawing, Exhibit 59.  
9 Do you recall?

10 A Yes.

11 Q In the lower right-hand corner, lower left-hand  
12 corner?

13 A Yes.

14 Q Are those delays also shown in Exhibit 27 or not?

15 A I haven't seen them. If you could help me --

16 Q No; I don't mean to imply that they're there by  
17 my question at all.

18 A I'm just trying to reply. I can indeed go through  
19 this in great detail. I wouldn't expect to find  
20 them here, but they may well appear. I know that  
21 the result of the instruction, the Dippy done  
22 pulse, display done, would be brought back to  
23 here; but I would not expect to see the delays  
24 here. But they could be; and I'll take time to

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Q

look if you wish.

I think perhaps I can ask you another question that will save you looking.

Is it true that the timing chain in Exhibit 27 has nothing to do with the timing of the display and the time required for the display, in the Type 30 display?

A

Yes.

MR. WELSH: I think you're leading the witness, Counsel.

MR. ANDERSON: This is cross-examination.

MR. WELSH: I'd like to object.

A

The display instruction IOT 07 that I testified to, that time is governed by the -- has to go through two machine cycles, which are indeed these twice down, or twice through, the timing chain.

Q

In Exhibit 27?

A

In Exhibit 27.

However, there is a space before you can return, or reenter, when you elect to hold up and wait for the display done.

Q

That's merely to provide a time gap in which to accomplish the display?

A

Well, I previously talked about the required,

1 necessary setup time!

2 Q The 50 microseconds minimum?

3 A Of 50 microseconds, yes; the 50 microseconds  
4 being somewhat less. The effect would be that  
5 you'd see -- if you intensified too soon, and  
6 this is sometimes done, you'd see the point  
7 moving in towards the addressed location.

8 Q Mr. McKenzie, with respect to your longhand sheet  
9 which has been marked as MIT Deposition Exhibit 8,  
10 when did you prepare that? -- that is the Serial

11 A Following receipt of the subpoena.

12 Q Do you know on what day?

13 A Oh, it was over a period of days. Maybe, when

14 I sit at my desk having lunch, I might have

15 looked through it or something. It was sort of  
16 fun to reread the logs. I would never have done  
17 it otherwise.

18 Q Are all of the entries on that page in your  
19 handwriting?

20 A With the exception of the deposition --

21 Q The Court Reporter's markings; yes.

22 What is the significance of the dates  
23 at an angle down on the left side?

24 A Oh, I did that during the first day of my trial,

1 when I learned that I was looking at Exhibits 4  
2 through 7.

3 MR. ANDERSON: Off the record.

4 [Discussion off the record.]

5 Q I'd like you to look at MIT Deposition Exhibit 24.  
6 I notice on the -- well, they're not numbered;  
7 but the sixth page, counting the cover, there is  
8 a photograph at the top of the page. Does that  
9 illustrate the PDP-1 as you know it?

10 A No. The first two PDP-1's -- that is the Serial  
11 No. 1 which I testified DEC kept in house, and  
12 the second one -- had the operator's console --  
13 I think I referenced a picture in Exhibit 10.

14 Q I'll place before you Exhibit 10., bolted

15 A Yes; Page 10, control panel, called. The first  
16 two had them, had the control panel on a separate  
17 table. This table was meant to be the table for  
18 the typewriter. We were surprised when we -- 10,  
19 we expected to receive this one, and indeed would  
20 have preferred this one; because this gives the  
21 user lots of space for his papers while he was  
22 sitting at the console. of the vertical columns  
23 is what I The model that we received was the  
24 prototype, or -- of the first repackaged model

1 of the PDP-1. That is the repackaged model having  
2 the console on one end of one of the bays.

3 Q And in other respects -- I guess, don't they?

4 A Such as the picture on -- well, I testified  
5 earlier, where's the front page of what I call  
6 the sales brochure? Yes. I'm describing one end  
7 of the -- I'm referencing the picture on the  
8 front page of Exhibit 50. That is the way that  
9 our PDP-1 was delivered.

10 Q Now, that was just one console or rack of the  
11 PDP-1 which you received; is that a part of it?

12 A In DEC's nomenclature and in the way it was  
13 generally understood, this is three bays of  
14 equipment, strapped down; that is, bolted  
15 together. And it came down in one piece. Within  
16 this, there are four bays. I'm not sure that I  
17 can find a picture of a bay to help describe it.

18 length, All right. In Exhibit 10, on Page 10,  
19 there is --

20 MR. WELSH: Excuse me. Page 6 of

21 A -- Page 6, there is a layout of space used and  
22 space reserved; and each of the vertical columns  
23 is what I've been calling a bay.

24 Q Is each one of those -- roughly six feet tall?

1 A Indeed, it is so marked on the layout that I'm  
2 Q describing.

3 Q They even have numbers, I guess, don't they?

4 A That's right; and these numbers are referenced  
5 in the drawing.

6 Q Bay 1, Bay 2, Bay 3; and what's the -- it looked

7 A Bay 11.

8 Q On the far left. This second, the picture on the

9 A And vertical height also carries a unique  
10 designation. This is so that every module in

11 these bays carries a unique designation. I

12 think I testified in one of the drawings earlier  
13 about a Location 3H, something or other.

14 Q Now, is each one of those bays roughly 19 inches  
15 wide, do you know?

16 A Yes.

17 Q So that the total is approximately 76 inches in  
18 length, as shown in Exhibit 6?

19 A Yes.

20 MR. WELSH: Excuse me. Page 6 of

21 Exhibit 10?

22 MR. ANDERSON: Page 6 of Exhibit 10;

23 thank you.

24 Q And are those bays each roughly six feet tall?



- 1 A Yes.
- 2 Q I'm six feet tall.
- 3 A Yes.
- 4 Q And in addition to that, what else makes up the
- 5 PDP in Room 260 of Building 26?
- 6 A Well, as first delivered, this is what it looked
- 7 like. We've been continually changing it after
- 8 the first year. This indeed, the picture on the,
- 9 front page of Exhibit 50, did indeed represent
- 10 what was delivered; and this is the way the total
- 11 configuration was until we received the Type 30
- 12 display. The picture on Page -- there's no page
- 13 number. Let's find a picture. We've earlier
- 14 looked at a picture of the Type 30 display in
- 15 Exhibit 10. MIT Position Exhibit 20, Dr.
- 16 McKeon, Page 34. This is the first. The
- 17 addition of a display was the first thing that
- 18 changed the appearance; and indeed made it --
- 19 this was the first change of any nature to the
- 20 PDP-1 from the initial receipt. on the tape; but
- 21 Q Is all of the electronics shown in MIT Deposition
- 22 Exhibit 59 contained in the table under the
- 23 display on Page 34 of Exhibit 10?
- 24 A Yes. All I can say is that the only listed

1 Q Is there anything else contained in that table  
2 underneath the display at Page 34 of Exhibit 10,  
3 power supplies or other portions of the PDP-1?

4 A Yes; there are power supplies. There is a power  
5 control panel with delays, turn-on delays.  
6 There are fans for cooling.

7 Q Are any portions of the PDP-1 contained in that  
8 table under the display at Page 34 of Exhibit 10,  
9 or are they all contained in the bays?

10 A I think of this as being -- I think of everything  
11 in that table as being part of the option; not  
12 part of the PDP-1.

13 Q Yes; all right. I just have one other area that  
14 I would like to ask about; and that is:

15 only I. In MIT Deposition Exhibit 20, Mr.  
16 McKenzie, there is reference on the first page  
17 near the bottom to a standard PDP-1 tape coding  
18 called Concise III. What is Concise III?

19 A It's funny. It obviously refers to the Flexo-  
20 writer code or the English code on the tape; but  
21 we have always continued to call it FIO-DEC.

22 This must be a wider industry -- well, there wasn't  
23 that much industry at that time.

24 All I can say is that the code listed

1 on -- the alphanumeric code that is listed on  
2 the back of Exhibit 49 is indeed the code of  
3 PDP-1.

4 Q Well, I notice on Exhibit 49 there are two  
5 columns. One is marked "FIO-DEC" and the other  
6 is marked "Concise," in adjacent columns. Are  
7 you familiar with the meaning of those two  
8 columns?

9 A We've always talked in terms of the FIO-DEC code;  
10 and for all our purposes, you will have the  
11 information that we use -- all right. I see now  
12 why they say "Concise." We only use the right-  
13 hand column; but we have incorrectly, all this  
14 time, been calling it the FIO-DEC code. Not  
15 only I.

16 MR. ANDERSON: That completes the  
17 cross-examination.

18 MR. WELSH: I'd like to suggest a few-  
19 minute recess to consult with my colleagues.

20 MR. ANDERSON: I'll stand by.

21 [Recess.]

22 MR. WELSH: I have no redirect  
23 examination.

24 MR. HERBERT: Nor do I.

1 MR. WELSH: I'd like to ask Mr. Anderson  
2 if we may stipulate that the witness may sign the  
3 original transcript before any notary public.  
4

5 MR. ANDERSON: That's quite acceptable;  
6 and I would like to state that we'd like to get  
7 copies of all these exhibits just as quickly as  
8 we can.

9 MR. WELSH: We will work toward that  
10 end.

11 That completes, then, the deposition.

12 THE WITNESS: How long am I going to --  
13 this signing means that I'm going to have to read  
14 through how many pages of testimony, now? How  
15 long a time do I have on that? I know there are  
16 limits on this.

17 MR. ANDERSON: Off the record on this.

18 [Discussion off the record.]

19 MR. WELSH: This, then, completes the  
20 deposition of Massachusetts Institute of Technology,  
21 and Mr. McKenzie.

22 MR. SANTA: May I say something? What  
23 about corrections? There may have been some  
24 inadvertent statements; like I know at one time  
he used the wrong name of a person. It's pretty

1 obvious to me. It was inadvertent error. I  
 2 mean, can he correct that in his copy before he  
 3 signs?

4 *Alexander M. [unclear], do hereby certify*  
 5 *that I have read MR. ANDERSON: Off the record.*  
 6 *testimony, and [Discussion off the record.] certify that*  
 7 *same is a true and correct copy of the deposition [Deposition concluded at 5:15 p.m.] and*  
 8 *testimony.*

-----

9 Dated at *San Francisco, California*, this  
 10 *11* day of *December*, 1975.

11 *[Signature]*  
 12 *[Signature]*

13  
 14 sworn and subscribed to before me this *11*  
 15 day of *December*, 1975.

16  
 17 *[Signature]*  
 18 *[Signature]*  
 19 *[Signature]*  
 20 *[Signature]*  
 21 *[Signature]*  
 22 *[Signature]*  
 23 *[Signature]*  
 24 *[Signature]*

1 COMMONWEALTH OF MASSACHUSETTS  
2 SUFFOLK, SS. C E R T I F I C A T E

3 I, John Alexander McKenzie, do hereby certify  
4 that I have read the foregoing transcript of my  
5 testimony, Pages 353 to 515, and further certify that  
6 said transcript is a true and accurate record of said  
7 testimony.

8 Dated at Cambridge, Massachusetts, this  
9 8th day of December, 1975.

10  
11 John Alexander McKenzie  
12 John Alexander McKenzie

13  
14 Sworn and subscribed to before me this 8th  
15 day of December, 1975.

16  
17 Hellie T. Ferris  
18 Notary Public  
My commission expires:

19 3-3-78

Doris O. Wong Associates